ANNUAL REPORT
to the
GOVERNMENTS
of
THE UNITED STATES and CANADA

COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD

Washhington, D.C. Ottawa (Ontario)

30 SEPTEMBER 1997

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD

C A N A D A • U N I T E D S T A T E S

CANADIAN SECTION
D. R. WHELAN, Chairman
J. Allan, Member

UNITED STATES SECTION
S. L. STOCKTON, Chairman
R. H. Wilkerson, Member

28 February 1998

The Honorable Madeleine Albright
Secretary of State
Washington, DC

The Honourable Ralph Goodale
Minister of Natural Resources
Ottawa, Ontario

Dear Secretary Albright and Minister Goodale:

Reference is made to the Treaty between the United States of America and Canada relating to co-operative development of the water resources of the Columbia River basin, signed at Washington, DC, on 17 January 1961.

In accordance with the provisions of Article XV paragraph 2(e), there is submitted herewith the thirty-third Annual Report, dated 30 September 1997, of the Permanent Engineering Board.

The report sets forth results achieved under the Treaty for the period from 1 October 1996 to 30 September 1997. For reasons explained in the report, the Board concludes that the requirements of the Treaty were not fully met during the report year.

Respectfully submitted:

For the United States

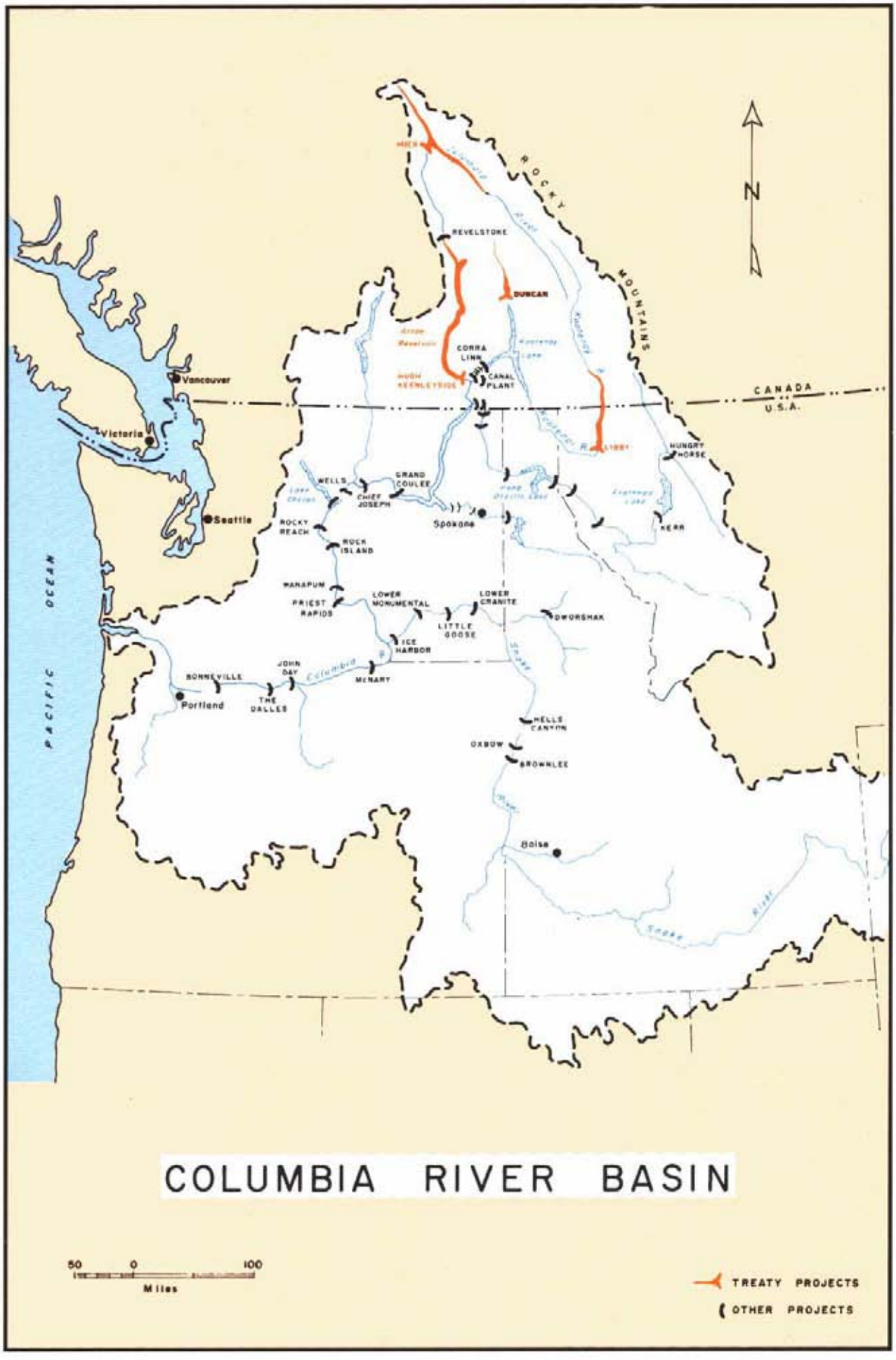
Steven Stockton, Chair

Ronald Wilkerson

For Canada

Dan Whelan, Chair

John Allan



COLUMBIA RIVER BASIN

ANNUAL REPORT

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THE UNITED STATES and CANADA

COLUMBIA RIVER TREATY

PERMANENT ENGINEERING BOARD

Washington, D.C. Ottawa, Ontario

30 September 1997

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SUMMARY

The thirty-third Annual Report of the Permanent Engineering Board is submitted to the governments of the United States and Canada in compliance with Article XV of the Columbia River Treaty of 17 January 1961. This report describes the status of projects, progress of Entity studies, operation of the Duncan, Arrow, Mica and Libby reservoirs, and the resulting benefits.

The Duncan, Arrow and Mica storage projects were operated throughout the year in accordance with the objectives of the Treaty and the terms of operating plans developed by the Entities. During the spring and summer of 1997, reservoir operations were controlled not only by power and flood control requirements, but also by environmental considerations to ensure adequate flows to meet fishery needs in both Canada and the United States.

The downstream power benefits to each country were 547.5 megawatts annual energy and 1373.4 megawatts of capacity for the August 1996 through July 1997 period. At Libby Dam, operations for the white sturgeon and salmon mandated by the requirements of the U.S. Endangered Species Act were implemented by the U.S. Army Corps of Engineers. The Canadian Entity disputes the U.S. Entity's authority under the treaty to unilaterally decide on these operations.

Normal operations at other Treaty reservoirs, as formulated in the 1996–1997 Detailed Operating Plan (DOP), were modified through Entity agreements. The use of non-Treaty storage was modified by corporate agreements to minimize interference between fishery requirements and power operations.

Operations under the 1990 and subsequent agreements between the Entities relating to the use of non-Treaty storage, refill enhancement for the Mica and Arrow reservoirs, and initial filling of non-Treaty reservoirs did not conflict with Treaty operations. The Columbia River Basin system was operated for flood control once during the winter of 1996-1997. The operations of the Treaty storage projects alone resulted in reducing the peak flows at the Dalles by 170,000 cfs during the spring of 1997. **The associated flood damage reduction benefits amounted to $(US)197,000,000.**

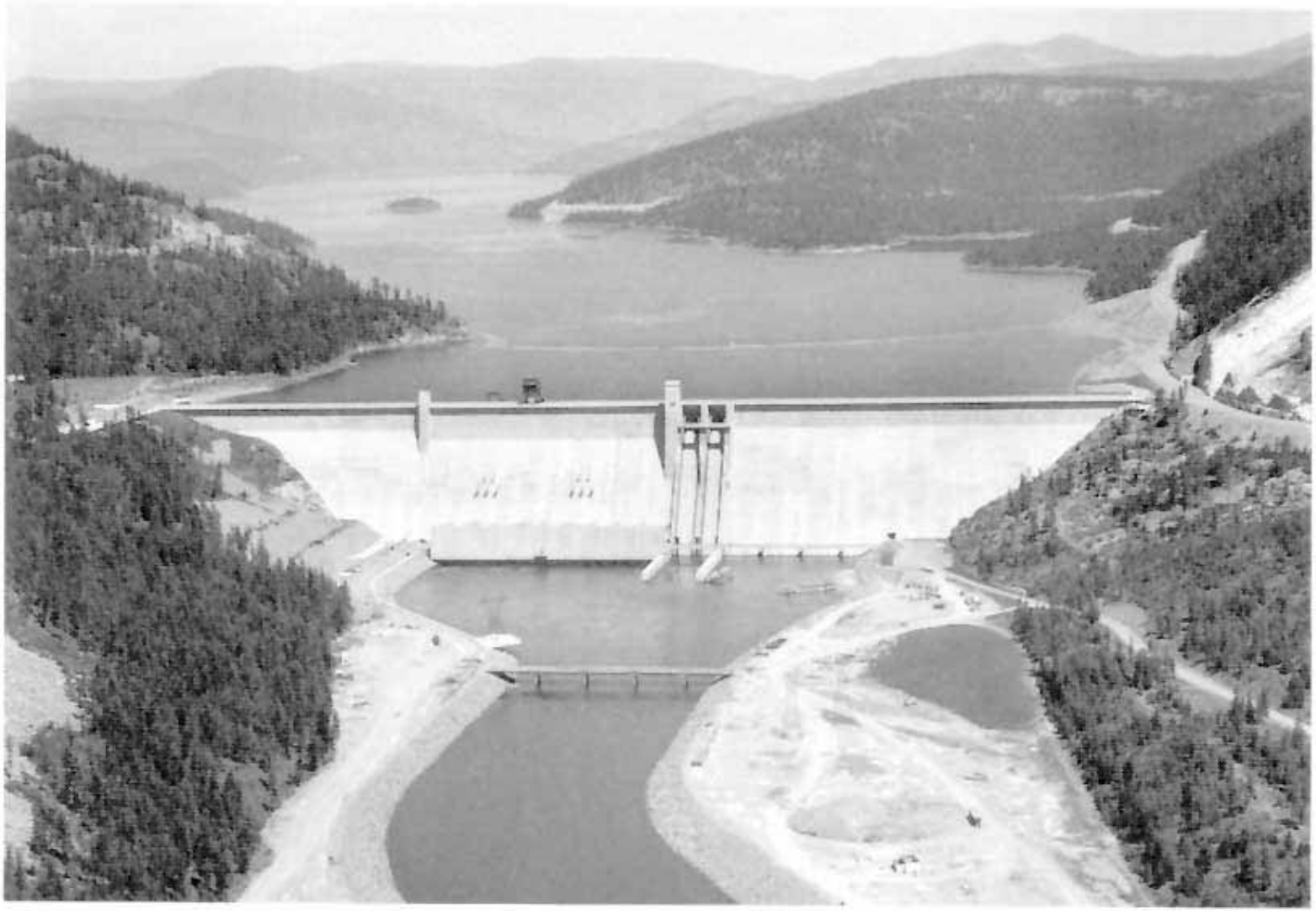
The disagreement over the operation of Libby has prevented the Entities from agreeing on the Assured Operating Plans (AOP) and Determinations of Downstream Power Benefits (DDPB) for operating years 2000–2001, 2001-2002 and 2002–2003. The Treaty requires the Entities to prepare an AOP and the associated DDPB for each operating year six years in advance. For this reason, the Board concludes that the requirements of the Treaty are not being fully met.

The Permanent Engineering Board is very concerned that the dispute between the United States and Canadian Entities over the Libby fisheries operations issue has not been resolved by the governments. The Board wishes the governments to understand that if the issue is not completely resolved by July 2000, the bases (AOP, DDPB, and Detailed Operation Plan (DOP)) for developing the hydropower and other benefits that accrue to both nations by the Treaty will no longer exist. Thus, the distinct possibility exists that those benefits will be lost to both nations beginning in operating year 2000-01.

INTRODUCTION

The Columbia River Treaty provides for the cooperative development of the water resources of the Columbia River basin. Article XV of the Treaty established a Permanent Engineering Board and specified that one of its duties is to "make reports to Canada and the United States of America at least once a year of the results being achieved under the Treaty."

This Annual Report, which covers the period 1 October 1996 through 30 September 1997, describes activities of the Board, progress being achieved by both countries under the terms of the Treaty, operation of the Treaty projects, and the resulting benefits. Summaries of the essential features of the Treaty and of the responsibilities of the Board and of the Entities are included. The report refers to items currently under review by the Entities, provides discussion regarding the operations of the Treaty reservoirs and of the resulting power and flood control benefits, and presents the conclusions of the Board.



Libby Dam - Kootenai River, Montana
The dam and reservoir, Lake Koocanusa. The powerhouse is at the left of the spillway.

THE COLUMBIA RIVER TREATY

General

The Columbia River Treaty was signed in Washington, D.C., on 17 January 1961 and was ratified by the United States Senate in March of that year. In Canada ratification was delayed. Further negotiations between the two countries resulted in a formal agreement by an exchange of notes on 22 January 1964 to a Protocol to the Treaty and to an Attachment Relating to Terms of Sale. The Treaty and related documents were approved by the Canadian Parliament in June 1964.

The Canadian Entitlement Purchase Agreement was signed on 13 August 1964. Under the terms of this agreement, Canada's share of downstream power benefits resulting from the first thirty years of scheduled operation of each of the storage projects was sold to a group of electric utilities in the United States known as the Columbia Storage Power Exchange.

On 16 September 1964, the Treaty and Protocol were formally ratified by an exchange of notes between the two governments. The sum of $253.9 million (U.S. funds) was delivered to the Canadian representatives as payment in advance for the Canadian entitlement to downstream power benefits during the period of the Purchase Agreement. On the same date, at a ceremony at the Peace Arch Park on the International Boundary, the Treaty and its Protocol were proclaimed by President Johnson of the United States, Prime Minister Pearson of Canada, and Premier Bennett of British Columbia.

Features of the Treaty and Related Documents

The essential undertakings of the Treaty are as follows:

(a) Canada will provide 15.5 million acre-feet of usable storage by constructing dams near Mica Creek, the outlet of Arrow lakes, and Duncan Lake in British Columbia.

(b) The United States will maintain and operate hydroelectric power facilities included in the base system and any new main-stem projects to make the most effective use of improved stream flow resulting from operation of the Canadian storage. Canada will operate the storage in accordance with procedures and operating plans specified in the Treaty.

(c) The United States and Canada will share equally the additional power benefit available in the United States as a result of river regulation by upstream storage in Canada.

(d) On commencement of the respective storage operations, the United States will make payments to Canada totalling $64.4 million (U.S. funds) for flood control provided by Canada.

(e) The United States has the option of constructing a dam on the Kootenai River near Libby, Montana. The Libby reservoir would extend some 42 miles into Canada, and Canada would make the necessary Canadian land available for flooding.

(f) Both Canada and the United States have the right to make diversions of water for consumptive uses and, in addition, after September 1984 Canada has the option of making for power purposes specific diversions of the Kootenay River into the headwaters of the Columbia River.

(g) Differences arising under the Treaty that cannot be resolved by the two countries may be referred by either country to the International Joint Commission or to arbitration by an appropriate tribunal as specified by the Treaty.

(h) The Treaty shall remain in force for at least 60 years from its date of ratification, 16 September 1964.

The Protocol of January 1964 amplified and clarified certain terms of the Columbia River Treaty. The Attachment Relating to Terms of Sale signed on the same date established agreement that under certain terms Canada would sell in the United States its entitlement to downstream power benefits for a 30-year period. The Exchange of Notes and Attachment Relating to Terms of Sale of January 1964 and the Canadian Entitlement Purchase Agreement of 13 August 1964 (the Sales Agreement) provided that the Treaty storage would be operative for power purposes on the following dates: Duncan storage on 1 April 1968; Arrow storage on 1 April 1969; and, Mica storage on 1 April 1973.

PERMANENT ENGINEERING BOARD

General

Article XV of the Columbia River Treaty established a Permanent Engineering Board consisting of two members to be appointed by Canada and two members by the United States. Appointments to the Board were to be made within three months of the date of ratification. The duties and responsibilities of the Board were also stipulated in the Treaty and related documents.

Establishment of the Board

Pursuant to Executive Order No. 11177 dated 16 September 1964, the Secretary of the Army and the Secretary of the Interior, on 7 December 1964, each appointed a member and an alternate member to form the United States Section of the Permanent Engineering Board. Pursuant to the Department of Energy Organization Act of 4 August 1977, the appointments to the United States Section of the Board are now made by the Secretary of the Army and the Secretary of Energy. The members of the Canadian Section of the Board were appointed by Order in Council P.C. 1964-1671 dated 29 October 1964. Each Canadian member was authorized to appoint an alternate member. On 11 December 1964, the two governments announced the composition of the Board.

The names of Board members, alternate members and secretaries are shown in Appendix A. Mr. Prad Kharé succeeded Mr. Jack Farrell as alternate member for Canada on 21 January 1997. Mr. George Bell succeeded Mr. Thomas Weaver as alternate member for the United States on 27 January 1997. Also, Mr. Daniel Burns retired as alternate member for the United States on 4 February 1997. The names of the current members of the Board's Engineering Committee are also shown in Appendix A.

Duties and Responsibilities

The general duties and responsibilities of the Board to the governments, as set forth in the Treaty and related documents, include:

(a) assembling records of the flows of the Columbia River and the Kootenay River at the Canada–United States of America boundary;

(b) reporting to Canada and the United States of America whenever there is substantial deviation from the hydroelectric and flood control operating plans and, if appropriate, including in the report recommendations for remedial action and compensatory adjustments;

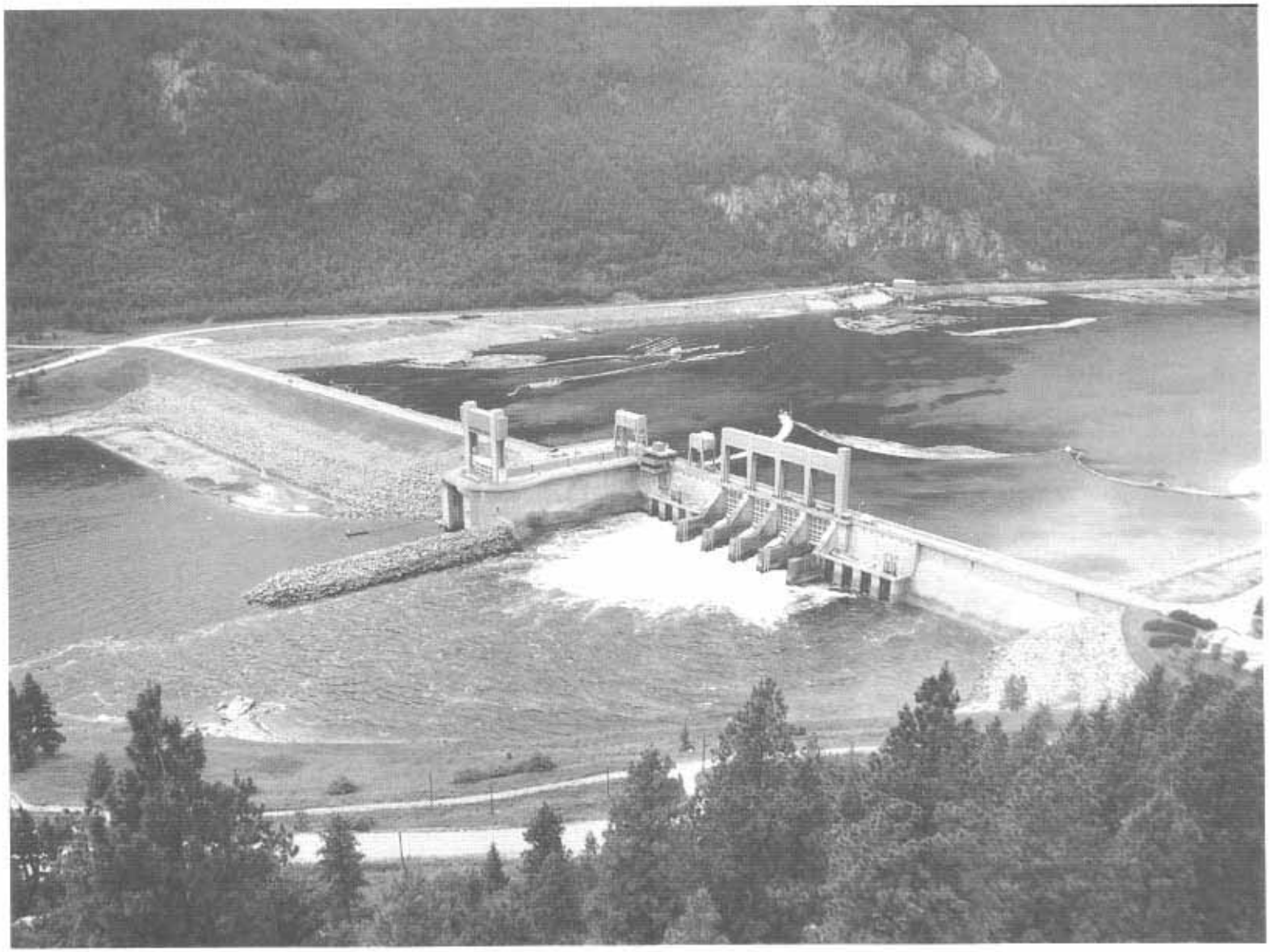
(c) assisting in reconciling differences concerning technical or operational matters that may arise between the Entities;

(d) making periodic inspections and requiring reports as necessary from the Entities and with a view to ensuring that the objectives of the Treaty are being met;

(e) making reports to Canada and the United States of America at least once a year of the results being achieved under the Treaty and making special reports concerning any matter that it considers should be brought to their attention;

(f) investigating and reporting with respect to any other matter coming within the scope of the Treaty at the request of either Canada or the United States of America; and

(g) consulting with the Entities in the establishment and operation of a hydrometeorological system as required by Annex A of the Treaty.



Hugh Keenleyside Dam (Arrow Lakes) - Columbia River, British Columbia
Concrete spillway and discharge works with navigation lock and earth dam.

ENTITIES

General

Article XIV(1) of the Treaty provides that Canada and the United States of America shall each designate one or more Entities to formulate and execute the operating arrangements necessary to implement the Treaty. The powers and duties of the Entities are specified in the Treaty and its related documents.

Establishment of the Entities

Executive Order No. 11177, previously referred to, designated the Administrator of the Bonneville Power Administration, the Department of the Interior, and the Division Engineer, North Pacific Division, Corps of Engineers, Department of the Army, as the United States Entity with the Administrator to serve as Chair. Pursuant to the Department of Energy Organization Act of 4 August 1977, the Bonneville Power Administration was transferred to the Department of Energy. Order in Council P.C. 1964-1407, dated 4 September 1964, designated the British Columbia Hydro and Power Authority as the Canadian Entity.

The names of the members of the Entities are shown in Appendix B. On 3 December 1996, Brigadier General Robert H. Griffin succeeded Colonel Bartholomew Bohn as Member of the U.S. Entity.

Powers and Duties of the Entities

In addition to the powers and duties specified elsewhere in the Treaty and related documents, Article XIV(2) of the Treaty requires that the Entities be responsible for the following:

(a) coordination of plans and exchange of information relating to facilities to be used in producing and obtaining the benefits contemplated by the Treaty;

(b) calculation of and arrangements for delivery of hydroelectric power to which Canada is entitled for providing flood control;

(c) calculation of the amounts payable to the United States for standby transmission services;

(d) consultation on requests for variations made pursuant to articles XII(5) and XIII(6);

(e) the establishment and operation of a hydrometeorological system as required by Annex A;

(f) assistance to and cooperation with the Permanent Engineering Board in the discharge of its functions;

(g) periodic calculation of accounts;

(h) preparation of the hydroelectric operating plans and the flood control operating plans for the Canadian storage together with determination of the downstream power benefits to which Canada is entitled;

(i) preparation of proposals to implement Article VIII and carrying out of any disposal authorized or exchange provided for therein;

(j) making appropriate arrangements for delivery to Canada of the downstream power benefits to which Canada is entitled including such matters as load factors for delivery, times and points of delivery, and calculation of transmission loss; and

(k) preparation and implementation of detailed operating plans that may produce results more advantageous to both countries than those that would arise from operation under the plans referred to in annexes A and B.

Article XIV(4) of the Treaty provides that the two governments may, by an exchange of notes, empower or charge the Entities with any other matter coming within the scope of the Treaty.

ACTIVITIES OF THE BOARD

Meetings

The Board held its 62nd meeting on 17 October 1996 in Portland, Oregon, and its 63rd meeting on 4 February 1997 in Vancouver, British Columbia. In conjunction with these meetings the Board also met with the Entities, the 43rd and 44th joint meetings, respectively.

At the 43rd Board-Entities meeting on 17 October 1996, the Entities presented to the Board, and discussed with them, two Entity Agreements: one resolving matters related to the calculation of the downstream power benefits, and the other solving the delivery of the Canadian entitlement questions. At the time of the meeting, only the former agreement (dated 29 August 1996) was finalized by the Entities. The Entities subsequently signed the latter agreement on 20 November 1996. The substance of these agreements is discussed later in the Power Operating Plans and Calculation of Downstream Benefits section (page 19) of this report. In letters dated 27 November and 9 December 1996, respectively, the U.S. and Canadian Entities advised the Board of their agreements and responded to the Board's letters to the Entities of 18 October 1995. The Entities' letters are reported in Appendix E. Concerning the disagreement between the Entities over operation of Libby Dam in response to the biological opinions on endangered fish species, the Entities reiterated the comments they expressed at the 22 February 1996 Board-Entity meeting, i.e., that the governments were dealing with this question.

On 4 February 1997, the Board met in Vancouver, British Columbia, to review progress under the Treaty and to finalize the Annual Report for the year ending 30 September 1996. On the same day, the Board met with the Entities to assess operations under the Treaty and to discuss the Entities' progress toward resolving the issues discussed at the 17 October 1996 Board-Entities meeting. The Board indicated to the Entities its concern with the method adopted by the Entities in their August 1996 agreement to resolve the issue of critical streamflow definition for the determination of Treaty downstream power benefits. In its separate meeting, the Board decided to place its concern in writing to the Entities and did so by similar letters to the United States and Candian Entities dated 28 March 1997. The Board's letters are reported in Appendix E. The Canadian and United States Entites replied to the Board by letters dated 28 March 1997 and 6 May 1997, respectively. Copies of those letters are also reported in Appendix F.

Reports Received

Throughout the report year, the Entities maintained contact with the Board and the Board's Engineering Committee. Information pertinent to the operation of Treaty storage projects was made available to the Board.

The following documents involving the operation of Columbia River Treaty Storage have been received by the Board from the Entities since the last annual report:

- Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for 1 April 1998 Through 15 September 2024 Between the Canadian Entity and the United States Entity, signed 20 November 1996.

  This agreement provides the principles and arrangements for the return of the Canadian Entitlement. It prescribes delivery over existing transmission lines and delivery points rather than over new transmission lines as would have been required for delivery to a point near Oliver, British Columbia. It also provides the principles for resolving other issues involved in the return such as the reliability and scheduling of the delivery and calculation of transmission losses.

- Columbia Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Whitefish Spawning for January 1 through April 30, 1997, signed 16 January 1997.

  This agreement supplements the 1996-97 DOP and was in effect for the period from January 1 to April 30, 1997. The objective of the agreement is to enhance mountain whitefish and trout spawning conditions in the Columbia River downstream from the Arrow project through the use of Treaty storage. This is accomplished by adjusting outflows from Arrow and is made possible by changes in the plan for storage and release of water at the Mica and Arrow projects from what would have been done under the DOP.

- Columbia Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Trout Spawning for March 1 through July 31, 1997, signed 4 April 1997.

  This agreement supplements the 1996-97 DOP and was in effect for the period from March 1 to July 31, 1997. The objective of this agreement is to enhance trout spawning conditions in the Columbia River downstream from the Arrow project through the use of Treaty storage. This is done by adjusting the outflows from Arrow and is made possible through changes in the plan for storage and release of water at Arrow from what would have been done under the DOP.

- U.S. Entity Record of Decision, Canadian Entitlement Allocation Extension Agreements, dated 29 April 1997.

  The Canadian Entitlement Allocation Agreements (CEAA), executed at the same time as the Columbia River Treaty in 1964, begin to expire in stages beginning in 1998. These agreements established how the downstream power benefits resulting from the storage provided by the Columbia River Treaty projects were to be attributed collectively to the six downstream Federal hydropower projects and to each of the five downstream non-Federal projects. The Record of Decision (ROD) describes the alternative arrangements considered and the process used to select the arrangement for the extension of the CEAA, and was prepared and signed by the U.S. Entity on 29 April 1997. The arrangement selected in this ROD attributes 72.5 percent of the entitlement to the six Federal hydroelectric projects and 27.5 percent to the five non-Federal projects. In addition to this ROD, there are five individual agreements that establish the arrangements for the extension of the CEAA with each of the utilities operating the five non-Federal projects (Priest Rapids, Wanapum, Wells, Rock Island, and Rocky Reach).

- Columbia River Treaty Entity Agreement on the Detailed Operating Plan for Columbia River Storage for 1 August 1997 through 31 July 1998, signed 30 July 1997.

  This agreement implements the Detailed Operating Plan (DOP) for Columbia River Storage for 1 August 1997 through 31 July 1998.

- Detailed Operating Plan for Columbia River Storage for 1 August 1997 through 31 July 1998, dated August 1997.

  This document serves as a guide and provides criteria for operation of the Columbia River Treaty storage during the operating year from August 1997 through July 1998. Further details on the DOP are provided in this report in the section pertaining specifically to the DOP.

- Agreement among the Columbia River Treaty Operating Committee and the Bonneville Power Administration and British Columbia Hydro and Power Authority on the Operation of Canadian Treaty and Libby Storage Reservoirs and Exchanges of Power for the Period 1 August 1997 through 16 January 1998, signed 4 August 1997.

  This agreement supplements the 1997-98 DOP. The objectives of the agreement include enhancement of Canadian trout spawning, U.S. flow augmentation, and power operations for both countries. It is accomplished by changes in the plan for storage and release of water from Canadian Treaty projects and the Libby project from what would have been done under the DOP.

- Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Mountain Whitefish Spawning for 20 September 1997 through 30 April 1998, signed 18 September 1997.

  This agreement supplements the 1997-98 DOP. It provides the US section with an option to request a provisional draft from Arrow Reservoir of up to 300 ksfd between 20 September and 19 December 1997, within certain discharge limitations. In return, Arrow reservoir outflows are to be reduced by up to 20 kcfs between 1 January 1998 and 15 January 1998 to facilitate storage of approximately 300 ksfd above the TSR levels. All provisional draft is to be returned to Arrow Reservoir by the end of April 1998.

- Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Fall Provisional Storage and Mountain Whitefish Spawning Flows from 11 October 1997 through 31 March 1998, signed 18 September 1997.

  This agreement supplements the 1997-98 DOP, and is in effect from 11 October 1997 through 31 March 1998. It provides the US section with an option to provisionally store in Kinbasket Lake (Mica) and/or transfer provisional storage from Arrow to Mica, in an amount up to the difference between the Treaty flood control rule curve and the composite month-end TSR content. All provisional storage between 11 October 1997 through 31 December 1997 will be returned during the period 16 January 1998 through 31 March 1998, with scheduling rights varying with the Arrow outflow for February 1998 projected in the 25 January 1998 TSR .

- Columbia River Treaty Operating Committee Agreement On Operation of Treaty Storage for Nonpower Uses For January 1 through July 31, 1998, signed 18 September 1997.

  This agreement supplements the 1997-98 DOP, and is similar to previous nonpower uses agreements signed by the Operating Committee. It includes principles for enhancement of Canadian trout spawning, U.S. flow augmentation, and Arrow lake level enhancement. It provides the framework for changes from the DOP in the plan for storage and release of water from Treaty projects.

- Annual Report of the Columbia River Treaty Canadian and United States Entities, for the period 1 October 1996 through 30 September 1997, dated November 1997.

  This report summarizes the operation of Treaty projects for the period 1 October 1996 through 30 September 1997.

The following documents involving the operation of Columbia River Non-Treaty Storage have been received by the Board from the Entities:

- Letter Agreement of January 17, 1997, between B.C. Hydro and Power Authority and Bonneville Power Administration, regarding Non-Treaty Storage for Enhancement of Whitefish Spawning.

  The term of this agreement is January 1 through December 15, 1997. The objective of the agreement is to enhance mountain whitefish spawning conditions in the Columbia River downstream from the Arrow project through the use of non-Treaty storage. This is done by adjusting the outflows from Arrow and is made possible through changes in the operation of non-Treaty storage at the Mica and Arrow projects.

- Letter Agreement of April 1, 1997, between B.C. Hydro and Power Authority and Bonneville Power Administration, regarding Non-Treaty Storage for Enhancement of U.S. Flow Augmentation.

  The term of this agreement is May 1 through August 31, 1997. The objective of the agreement is to use non-Treaty storage to enhance flow augmentation in the U.S. on the lower Columbia River during July and August. This is done by storage and release of water from non-Treaty storage at the Mica project.

Under the reporting schedule that has been agreed upon by the Board and the Entities, three additional documents, those listed below, would normally have been received at this time. However, due to a lack of agreement between the Entities over differences in energy and power benefits resulting from operation of Libby Dam with and without releases for endangered fish species, the Entities have not submitted them.

"Columbia River Treaty Assured Operating Plan and Determination of Downstream Power Benefits for the Operating Year 2000-01."

"Columbia River Treaty Assured Operating Plan and Determination of Downstream Power Benefits for the Operating Year 2001-02."

"Columbia River Treaty Assured Operating Plan and Determination of Downstream Power Benefits for the Operating Year 2002-03."

Report to Government

The thirty-second Annual Report of the Board was submitted to the governments of Canada and the United States of America on 28 February 1997.

Duncan Dam - Duncan River, British Columbia
The earth dam with discharge tunnels to the left and spillway to the right.

PROGRESS

General

The results achieved under the terms of the Treaty include construction of the Treaty projects, development of the hydrometeorological network, annual preparation of power and flood control operating plans, and the annual calculation of downstream power benefits. The three Treaty storage projects in British Columbia-the Duncan, Arrow and Mica projects- produce power and flood control benefits in Canada and the United States. The Libby storage project also provides power and flood control benefits in both countries. In the United States, increased flow regulation provided by Treaty projects facilitated the installation of additional generating capacity at existing plants on the Columbia River. In Canada, completion of the Canal Plant on the Kootenay River in 1976, installation of generators at Mica Dam in 1976–1977, and the completion of the Revelstoke project in 1984 have caused power benefits to increase substantially. This amounts to some 4,000 megawatts of generation capacity in Canada that may not have been installed without the Treaty. In addition, the installation of 150 MW generating capacity at Hugh Keenleyside Dam and additional generating units at Revelstoke Dam in Canada are planned for the future.

The Treaty provides Canada with an option, which commenced in 1984, of diverting the Kootenay River at Canal Flats into the headwaters of the Columbia River. The British Columbia Hydro and Power Authority completed engineering feasibility and detailed environmental studies of the potential diversion. No further activities are planned at this time.

The locations of the above projects are shown on Plate 1 in Appendix C.

Status of the Treaty Projects

Duncan Project

Duncan Dam, the smallest Treaty project, was scheduled in the Sales Agreement for operation by 1 April 1968, and was the first of the Treaty projects to be completed. It became fully operational on 31 July 1967, well in advance of Treaty requirements.

The earthfill dam is about 130 feet high and extends 2,600 feet across the Duncan River valley, approximately six miles north of Kootenay Lake. The reservoir behind the dam extends for about 27 miles and provides 1,400,000 acre-feet of usable storage, which is committed under the Treaty. There are no power facilities included in this project.

The project is shown in the picture on page 15, and project data are provided in Table 1 of Appendix D.

Arrow Project

The Hugh Keenleyside Dam, at the outlet of the Arrow Lake, was the second Treaty project to be completed. It became operational on 10 October 1968, well ahead of the date of 1 April 1969 scheduled by the Sales Agreement. The project at present has no associated power facilities; however, a proposal to install two generating units, totaling approximately 150 megawatts of generating capacity is currently being reviewed by the province of British Columbia and the Canadian government.

The dam consists of two main components: a concrete gravity structure that extends 1,200 feet from the north bank of the river and includes the spillway, low-level outlets, and navigation lock; and an earthfill section that rises 170 feet above the river bed and extends 1,650 feet from the navigation lock to the south bank of the river. The reservoir, about 145 miles long, includes both the Upper and Lower Arrow lakes, and provides 7,100,000 acre-feet of Treaty storage.

The project is shown in the picture on page 7, and project data are provided in Table 2 of Appendix D.

Mica Project

Mica Dam, the largest of the Treaty projects, was scheduled by the Sales Agreement for initial operation on 1 April 1973. The project was declared operational and commenced storing on 29 March 1973.

Mica Dam is located on the Columbia River about 85 miles north of Revelstoke, British Columbia. The earthfill dam rises more than 800 feet above its foundation and extends 2,600 feet across the Columbia River valley. It creates a reservoir 135 miles long, Kinbasket Lake, with a total storage capacity of 20,000,000 acre-feet. The project utilizes 12,000,000 acre-feet of live storage, of which 7,000,000 acre-feet are committed under the Treaty.

Although not required by the Treaty, a powerhouse was added to the project by B.C. Hydro and Power Authority. The underground powerhouse has space for a total of six 434-megawatt units, with a total capacity of 2,604 megawatts. At present, four generators are in operation, for a total of 1,736 megawatts.

The project is shown in the picture on page 23, and project data are provided in Table 3 of Appendix D.

Libby Project in the United States

Libby Dam is located on the Kootenai River, 17 miles northeast of the town of Libby, Montana. Construction began in the spring of 1966; storage has been fully operational since 17 April 1973. Commercial generation of power began on 24 August 1975, which coincided with the formal dedication

of the project. The concrete gravity dam is 3,055 feet long, rises 370 feet above the river bed and creates Lake Koocanusa, which is 90 miles long and extends 42 miles into Canada. Lake Koocanusa has a gross storage of 5,869,000 acre-feet, of which 4,980,000 acre-feet are usable for flood control and power purposes. The Libby powerhouse, when completed in 1976, had four units with a total installed capacity of 420 megawatts.

Construction of four additional units was initiated during fiscal year 1978, and the turbines have been installed. However, Congressional restrictions imposed in the 1982 Appropriations Act provide for completion of only one of these units. That unit became available for service late in 1987. The total installed capacity for the five units is 525 megawatts. Recent U.S. legislation (Public Law 104-303, 12 Oct. 1996) authorized the Corps of Engineers to construct and install generating units 6 through 8. No action to do so has been taken during this report period.

The Libby project is shown in the picture on page 2, and project data are provided in Table 4 of Appendix D.

Libby Project in Canada

Canada has fulfilled its obligation to prepare the land required for the 42-mile portion of Lake Koocanusa in Canada. British Columbia Hydro and Power Authority is now responsible for reservoir maintenance, debris clean-up and shoreline activities.

Hydrometeorological Network

One of the responsibilities assigned to the Entities by the Treaty is the establishment and operation, in consultation with the Permanent Engineering Board, of a hydrometeorological system to obtain data for detailed programming of flood control and power operation. This system includes snow courses, meteorological stations and stream flow gauges. The Columbia River Treaty Hydrometeorological Committee, formed by the Entities, makes recommendations on further development of the Treaty Hydrometeorological System.

In developing the hydrometeorological network, the Entities, with the concurrence of the Board, adopted a document in 1976 that defines the Columbia River Treaty Hydrometeorological System Network and sets forth a method of classifying facilities into those required as part of the Treaty System and those of value as Supporting Facilities. During the 1976–1977 report year, the Entities, with the concurrence of the Board, adopted a plan for exchange of operational hydrometeorological data. That plan is still in force.

In the 1985–1986 report year, the Entities provided the Board with the report, Revised Hydrometeorological Committee Documents, dated November 1985. The list of hydrometeorological facilities included in this document, which constitute the network, was updated by the Entities in 1987, 1989 and 1990.

Power Operating Plans and Calculation of Downstream Benefits

The Treaty and related documents require the Entities to agree annually on operating plans and on the resulting downstream power benefits for the sixth succeeding year of operation. These operating plans, prepared five years in advance, are called assured operating plans. They represent the basic commitment of the Canadian Entity to operate the Treaty storage in Canada (Duncan, Arrow and Mica) and provide the Entities with a basis for system planning. Canada's commitment to operate under an assured operating plan is tied directly to the benefits produced by that plan. At the beginning of each operating year, a detailed operating plan, which includes the three Treaty storage projects in Canada and the Treaty project in the United States (Libby), is prepared on the basis of current resources and loads to obtain results that may be more advantageous to both countries than those which would be obtained by operating in accordance with the assured operating plan.

Near the end of the 1987-88 report year, the Entities signed two agreements relating to changes in the principles and procedures used in preparing the assured operating plans and in calculating downstream power benefits. These agreements were based on Entity studies of the impact of several proposed changes to Treaty reservoir operating procedures and to the determination of downstream power benefits. The Entities' report: *Columbia River Treaty Principles and Procedures for Preparation and Use of Hydroelectric Operating Plans*, dated December 1991, provides guidelines for the preparation of the operating plans and incorporates the Entities' agreements.

In 1992, the Entities submitted to the Board its report entitled: *Assured Operating Plan (AOP) and Determination of Downstream Power Benefits (DDPB) for Operating Year 1996-1997.* The report established operating rule curves for the three Treaty storage reservoirs in Canada and calculated the downstream power benefits resulting from the operation of the reservoirs for the 1996-1997 operating year.

During the report year, actual operations of the Treaty storage in Canada were regulated under the rule curves set out in the Entities' report: *Detailed Operating Plan (DOP) for Columbia River Treaty Storage, 1 August 1996 through 31 July 1997*, and in associated Entities' agreements. This year's DOP uses the load, resources and non-power requirements from the 1996-1997 AOP rather than using the Pacific Northwest Coordination Agreement (PNCA) operating data, as has been done in previous DOPs. This was done because actual PNCA operations in the U.S. system are based on the U.S. Fish and Wildlife Service (FWS) and the National Marine Fishery Service (NMFS) Biological Opinions and associated non-power requirements and the Entities could not agree to use these updates in the DOP. One of the main measures defined in the Biological Opinions includes changing the customary seasonal release rates from Libby Dam such that spring and summer flows would be higher, and fall and winter flows lower, than in the past.

The Canadian Entity believes that these fishery operations are not consistent with the Treaty. The DOP for the operating year 1996-1997 shows the divergence of opinions between the Entities on the Libby fishery operation by displaying two sets of operating rule curves for the project. While the rule curves defined by the U.S. Entity include the flow regime specified in the FWS and NMFS' Biological Opinions, the Canadian Entity's rule curves reflect the earlier agreements between the Entities. Given

that the Entities have been unable to reach an agreement on the operation of the Libby project since early 1995, the two governments have initiated discussions to resolve the question.

At the forty-third Board-Entity meeting on 17 October 1996, the Entities presented to the Board, and discussed the following document (dated 29 August 1996): *Entity Agreement on Resolving the Dispute on Critical Period Determination, the Capacity Entitlement for the 1998/1999, 1999/2000, and 2000/2001 AOP/DDPB's, and Operating Procedures for the 2001/2002 and Future AOPs*. As reported in the 1996 Annual Report, this document essentially brought the AOP and DDPB reports for the operating years 1998-1999 and 1999-2000 into compliance with the Treaty and provides a basis for preparing future AOP and DDPB reports.

According to the Entities, the agreement will produce results equivalent to those that would have occurred had the Board's recommendations on this issue[1] been implemented by the Entities exactly as proposed. This is explained by the Entities' desire to reach a mutually beneficial agreement which gives the Canadian Entity equivalent benefits to those anticipated by implementing the Board's recommendations, while preserving the U.S. Entity's position that it does not accept these recommendations.

The Board is pleased that the Entities have reached an agreement resolving, for the foreseeable future, the long-standing calculation of the downstream power benefits issue (i.e. the critical streamflow period definition and the established operating procedures issues). However, as the Entities did not implement the Board's Recommendations exactly as proposed, the Board remains concerned that this issue may arise again in the future as there is a remote possibility that using both of the Entities' interpretations of the critical streamflow period definition may not lead to a single value of the downstream power benefits. The Board conveyed these concerns to the Entities during the 4 February 1997 Board-Entity meeting and by a letter to the Entities dated 27 March 1997 (the letter together with the replies from the Entities are contained in Appendix E). If this issue is raised in the future, the Board will re-examine the matter by using its recommendations as guidelines on the appropriate Treaty interpretation and application of the critical streamflow period definition and the established operating procedures.

In November and December 1996, the Entities advised the Board in separate letters that an agreement detailing arrangements for the return of the Canadian Entitlement had been signed. This agreement, dated November 20, 1996 and entitled: *Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for April 1, 1998 through September 15, 2024 Between the Canadian Entity and the United States Entity* resolves the previously outstanding issues relating to the point of delivery and east-west standby transmission.

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[1] A complete description of the Board's recommendations (dated 18 October 1995) can be found in Appendix F of the Board's 1995 Annual Report.

While the substantive issues relating to the calculation of the downstream power benefits and the appropriate arrangements for their return to Canada have now been resolved, the Libby fishery operation issue remains outstanding, and needs to be resolved. The Entities indicate they will not sign agreements to implement the AOP and DDPB reports for the years 2000-01, 2001-02 and 2002-03, which are now overdue, without resolution of the issue of whether or not the Libby Dam water control operations for endangered species (salmon and sturgeon) should be included in the AOP.

The Canadian Entity's main concern with the fisheries operations is that they reduce the extent to which Libby can be coordinated with downstream projects in Canada. Depending on water conditions, this reduced coordination reduces the benefit of Libby storage releases on the Canal Plant Project in B.C. The U.S. has taken the position that in order to comply with the Biological Opinions pursuant to the U.S. Endangered Species Act, special water control operations must be carried out at Libby. This matter is currently being reviewed by the governments. Until the issue is resolved, the Entities will not agree on the AOP/DDPB reports noted above.

The PEB is very concerned that the Entities are not in full compliance with Treaty requirements due to their inability to agree on an AOP and the DDPB for operating years 2000-01, 2001-02 and 2002-03 because of the Libby fishery operation issue. As discussed in this section of the report, the differing Entity positions on Libby, if not resolved by July 2000, may adversly impact the operation of the Canadian Treaty reservoirs and will prohibit the determination of the downstream benefits those reservoirs produce.

From the U.S. perspective, there will be no assured plan of operation for the Canadian Treaty reservoirs and thus no basis for the development of a Detailed Operating Plan for operating year 2000-01. From the Canadian perspective, there will be no accounting of the Canadian entitlement to one half of the downstream benefits resulting from operation of the Canadian Treaty reservoirs.

Both the AOP and DDPB are required to be completed six years in advance by paragraph 9, Annex A of the Treaty. The completion of the AOP and DDPB six years in advance were important considerations during the original Treaty negotiations. The inability of the Entities to meet these provisions of the Treaty most assuredly will create potential for in a loss of Treaty benefits to both nations.

Flood Control Operating Plans

The Treaty provides that Canadian storage reservoirs will be operated by the Canadian Entity in accordance with operating plans designed to minimize flood damage in the United States and Canada. The *Columbia River Treaty Flood Control Operating Plan,* dated October 1972, defines flood control operation of the Duncan, Arrow, Mica and Libby reservoirs. This plan was received from the Entities and reviewed by the Board in the 1972–1973 report year and is still in effect. The plan is currently being revised and should be completed by the fall of 1998.

An analysis of the potential reallocation of flood control space in Mica and Arrow reservoirs was completed by the U.S. Entity and agreed to by both Entities. This analysis concludes that the maximum flood control draft from Arrow (not including on-call flood control storage) can be reduced from 5.1 maf to 3.6 maf with a corresponding increase in the maximum flood control draft from Mica to 4.08 maf. System flood control at The Dalles would not be affected by this change. This proposed flood control space reallocation has not been implemented at this time. The Canadian Entity may do so in the future at its discretion.

Flow Records

Article XV(2)(a) of the Treaty specifies that the Permanent Engineering Board shall assemble records of flows of the Columbia and Kootenay rivers at the Canada-United States of America boundary. Flows for this report year are tabulated in Appendix C for the Kootenai River at Porthill, Idaho, and for the Columbia River at Birchbank, British Columbia.

Non-Treaty Storage

Since 1984 there have also been agreements between the B.C. Hydro and Power Authority and the Bonneville Power Administration concerning non-Treaty storage. These agreements do not interfere with operations under the Treaty; rather, they extend the concepts of the Treaty and benefit both the B.C. Hydro and Power Authority and the Bonneville Power Administration.

Operations for Fish

Many U.S. reservoirs are presently operated in accordance with biological opinions issued by the U.S. Fish and Wildlife and the National Marine Fishery Service under the Endangered Species Act. Treaty reservoirs, in Canada, are operated in accordance with the requirements of the Canadian Department of Fishery and Oceans. These efforts continue to evolve. In this regard, the Board notes that the assured operating plans and the determination of downstream power benefits are to provide for optimal operation for power and flood control in accordance with the requirements of the Treaty. The Board has also noted, however, that the Entities may agree to provide water for fish under detailed operating arrangements providing those actions do not conflict with the Treaty requirements.

Mica Dam and Lake Kinbasket - Columbia River, British Columbia
The earth dam showing the spillway at the right. The underground powerhouse is at the left.

OPERATION

General

The Columbia River Treaty Operating Committee was established by the Entities to develop operating plans for the Treaty storage and to direct operation of this storage in accordance with the terms of the Treaty and subsequent Entity agreements.

During the report year, the Treaty storage in Canada was operated by the Canadian Entity in accordance with the following documents:

- Columbia River Treaty Flood Control Operating Plan, dated October 1972, as amended by the Review of Flood Control, Columbia River Basin, Columbia River and Tributaries Study, CRT-63, dated June 1981.

  This agreement prescribes the criteria and procedures by which the Canadian Entity will operate Mica, Duncan, and Arrow Projects, and the United States will operate Libby Project to achieve the desired flood control objectives in the United States and Canada;

- Columbia River Treaty Entity Agreement on Principles for Preparation of the Assured Operating Plan and Determination of Downstream Power Benefits, dated July 1988.

  This agreement states principles for changes in the preparation of the AOP's and DDPB's. These changes involve revisions of information to be used in studies such as the definition of the power loads and generating resources in the Pacific Northwest area, streamflows to be used, estimates of irrigation withdrawals and return flows, and other related information;

- Columbia River Treaty Entity Agreement on Changes to Procedures for the Preparation of the Assured Operating Plan and Determination of Downstream Power Benefit Studies, dated August 1988.

  This agreement states the specific procedures to be used in implementing the previous agreement on Principles for Preparation of the Assured Operating Plan and Determination of Downstream Power Benefits;

- Agreement executed by the United States of America Department of Energy acting by and through the Bonneville Power Administration and British Columbia Hydro and Power Authority relating to: (a) Use of Columbia River non-Treaty Storage, (b) Mica and Arrow Refill Enhancement, and (c) Initial Filling of non-Treaty Reservoirs, signed 9 July 1990.

This agreement provides information relating to the initial filling of Revelstoke Reservoir, the coordinated use of some of the Columbia River non-Treaty storage, and actions taken to enhance the refill of the reservoirs impounded by Mica and Arrow Dams;

- Columbia River Treaty Principles and Procedures for Preparation and Use of Hydroelectric Operating Plans, dated December 1991.

  This document serves as a guide for the preparation and use of hydroelectric operating plans such as the Assured Operating Plans and Detailed Operating Plans used to plan the operation of Columbia River Treaty Storage;

- Assured Operating Plan for Columbia River Treaty Storage, 1 August 1996 through 31 July 1997, dated February 1992.

  This document provides information on the operation plan for Columbia River Treaty storage and resulting downstream power benefits for the period 1 August 1996 through 31 July 1997;

- Columbia Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Whitefish Spawning for January 1 through April 30, 1997, signed 16 January 1997.

  This agreement supplements the 1996-97 DOP and was in effect for the period from January 1 to April 30, 1997. The objective of the agreement is to enhance mountain whitefish and trout spawning conditions in the Columbia River downstream of Arrow through the use of Treaty storage. This is accomplished by adjusting outflows from Arrow and is made possible by changes in the plan for storage and release of water in Mica and Arrow from what would have been done under the DOP;

- Columbia Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Trout Spawning for March 1 through July 31, 1997, signed 4 April 1997.

  This agreement supplements the 1996-97 DOP and was in effect for the period from March 1 to July 31, 1997. The objective of this agreement is to enhance trout spawning conditions in the Columbia River downstream of Arrow through the use of Treaty storage. This is done by adjusting the outflows from Arrow and is made possible through changes in the plan for storage and release of water in Arrow from what would have been done under the DOP;

- Columbia River Treaty Entity Agreement on the Detailed Operating Plan for Columbia River Storage for 1 August 1997 through 31 July 1998, signed 30 July 1997.

  This agreement implements the Detailed Operating Plan (DOP) for Columbia River Storage for 1 August 1997 through 31 July 1998;

- Detailed Operating Plan for Columbia River Storage for 1 August 1997 through 31 July 1998, dated August 1997.

  This document serves as a guide and provides criteria for operation of the Columbia River Treaty storage during the operating year from August 1997 through July 1998. Further details on the DOP are provided in this report in the section pertaining specifically to the DOP;

- Agreement among the Columbia River Treaty Operating Committee and the Bonneville Power Administration and British Columbia Hydro and Power Authority on the Operation of Canadian Treaty and Libby Storage Reservoirs and Exchanges of Power for the Period 1 August 1997 through 16 January 1998, signed 4 August 1997.

  This agreement supplements the 1997-98 DOP. The objectives of the agreement include enhancement of Canadian trout spawning, U.S. flow augmentation, and power operations for both countries. It is accomplished by changes in the plan for storage and release of water from Canadian Treaty projects and Libby Reservoir from what would have been done under the DOP; and,

- Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Mountain Whitefish Spawning for 20 September 1997 through 30 April 1998, signed 18 September 1997.

  This agreement supplements the 1997-98 DOP. It provides the US section with an option to request a provisional draft from Arrow Reservoir of up to 300 ksfd between 20 September and 19 December 1997, within certain discharge limitations. In return, Arrow reservoir outflows are to be reduced by up to 20 kcfs between 1 January 1998 and 15 January 1998 to facilitate storage of approximately 300 ksfd above the TSR levels. All provisional draft is to be returned to Arrow Reservoir by the end of April 1998.

Power Operation

The three Canadian Treaty storage projects, Duncan, Arrow and Mica, and the one U.S. Treaty storage project, Libby Dam, were in operation throughout the report year.

The summer of 1996, preceding the beginning of the report year, saw the coordinated Columbia River reservoir system filled to 99.5 percent of capacity. As a result, first-year firm load carrying capability (FLCC) was adopted for the 1996-97 operating year. Due to greater than average streamflows throughout the year, the system generally operated to the Operating Rule Curve or Flood Control Rule Curve for the entire period.

During the spring and summer of 1997, reservoir operations were controlled not only by power and flood control requirements, but also by environmental considerations to ensure adequate flows to meet fishery needs in both Canada and the United States. At Libby Dam, operations for the white sturgeon and salmon mandated by the requirements of the U.S. Endangered Species Act were implemented by the U.S. Army Corps of Engineers. The Canadian Entity disputes the U.S. Entity's authority under the treaty to unilaterally decide on this operation. Discussions between the Canadian and U.S. governments continued in an effort to resolve this issue. Normal operations at other Treaty reservoirs, as formulated in the 1996–1997 Detailed Operating Plan, were modified through Entity agreements. The use of non-Treaty storage was modified by corporate agreements to minimize interference between fishery requirements and power operations.

The coordinated Columbia River reservoir system reached 99.09 percent of its maximum storage energy by the end of July 1997. This value was used to determine the FLCC, with the result that first-year FLCC was adopted for the 1997–1998 operating year.

Mica Project

The Mica Treaty storage volume reached 6.7 million acre-feet (maf) which was 95 percent of full content on 31 July 1996. Mica Treaty storage continued to fill during August reaching full Treaty Storage of 7.0 maf on 12 August, 1996. The reservoir exceeded full pool elevation between 31 August and 3 September 1996 and reached a peak elevation of 2475.4 feet on 1 September 1996. Kinbasket Lake began the report year (1 October 1996 to 30 September 1997) at elevation 2,471.3 feet, about 3.7 feet below its full level.

Throughout the fall of 1996, Treaty storage in Mica was generally drafted for power purposes. The reservoir was drafted to elevation 2427.2 feet by 31 December 1996.

During the period beginning in January and continuing through April, the reservoir was drafted for power purposes and reached its lowest level of the year, elevation 2383.6 feet on 25 April 1997. This level was 21 feet lower than the previous year's lowest level. Mica Treaty storage reached a minimum of 0.1 million acre-feet on 30 April 1997. With the start of the spring freshet in early May, Mica discharges were reduced and the reservoir quickly refilled. On 31 July 1997, the elevation

of the reservoir was 2470.8 feet and Treaty storage was 6.6 maf. The reservoir remained within a foot of full pool elevation between 8 August to 19 August 1997 before receding. The Mica Treaty storage reached full on 12 August 1997. The reservoir reached the peak level for the year of 2474.5 feet (0.1 feet below full) at the end of the report year on 30 September 1997.

Arrow Project

Arrow Lake began the report year on 1 October 1996 at elevation 1,428.4 feet, 15.6 feet below full, after a summer in which the reservoir reached a peak elevation of 1,442.6 feet on 10 July 1996. Reservoir releases decreased over the fall months from an average of 55 thousand cubic feet per second (kcfs) in October to an average of 45 kcfs in December. Arrow reservoir was drafted to elevation 1,418.1 feet by 31 December 1996, and Arrow Treaty storage on that date was 4.9 maf, or 68 percent of full.

In early January, the Canadian Entity requested that Arrow outflows be selectively reduced below Treaty requests to keep river levels at acceptable and maintainable levels during whitefish spawning and later emergence. The U.S. Entity agreed to this request under terms of the Non- Power Uses Agreement. During the period from January through March, the reservoir continued to be drafted. The reservoir reached its lowest level of the period, elevation 1,389.5 feet, on 31 March 1997. During the period from April through June, Arrow was operated under the terms of two Operating Committee agreements for Operation of Treaty Storage for Enhancement of Whitefish and Trout spawning. These agreements allowed the Arrow project flows to be maintained and avoid de-watering rainbow trout redds.

Arrow reservoir reached its highest level of the year, elevation 1,444.1 feet, on 31 July 1997 slightly above the full pool elevation of 1444 feet. The Arrow Treaty storage content corresponding to this elevation was 7.1 maf, or 100 percent full. By the end of the reporting period, 30 September 1997, Arrow reservoir had been drafted to elevation 1432.2 feet with a Treaty storage content of 6.4 maf, or 90 percent of full content.

To minimize spill at the downstream Kootenay River plants in Canada and maintain water levels in Lake Koocanusa in Canada and the United States, the Canadian and U.S. Entities agreed to a Libby-Arrow water transfer for the late summer of 1997. Under this agreement, Libby release volumes were reduced by about a total of 190 thousand second foot-days (ksfd) through August, and an equal amount of water was released from Arrow reservoir. This Arrow water that was effectively stored in Libby during August was to be returned to Arrow reservoir in the September 1997 to January 1998 period.

Duncan Project

Duncan reservoir refilled to elevation 1892.2 feet on 31 July 1996, which is 0.2 feet above the full pool elevation of 1892.0 feet. During the month of September, an average of 5.5 kcfs was discharged to maintain the Kootenay Lake flows and lake levels. This resulted in a reservoir elevation of 1892.2 feet at the start of the report year on 1 October 1997. The project discharge was reduced to an average of 3.5

kcfs in October and remained there for most of November, dropping off to 2 kcfs in the first half of December. Higher discharges were necessary again between mid- December to February to again support Kootenay Lake levels and flows. The reservoir elevation was 1,857.4 feet (58 percent of full) on 31 December 1996.

The reservoir was drafted throughout February to mid-March to meet Kootenay Lake IJC levels. The reservoir exceeded its Treaty flood control curve slightly near the end of February and then continued to draft another 6 feet below the flood control curve between March until it reached its lowest level for the year at elevation 1796.6 feet (2.2 feet above empty) on 1 May 1997. Beginning in May, the reservoir was returned to its minimum outflow of 100 cfs to start the refill process. It remained on minimum discharge until 4 July, when the outflow was increased to slow the rate of reservoir refill. The Duncan reservoir reached full pool at elevation 1892.0 feet on 15 July 1997 and exceeded it by 0.1 feet on 30 July 1997. During the month of August, inflow was adequate to maintain the reservoir near full pool, and on 1 September, the discharge was increased to start drafting the reservoir and fill Kootenay Lake. The reservoir was drafted to elevation 1889.8 feet by 30 September 1997.

Libby Project

Lake Koocanusa started the operating year on 1 August 1996 at elevation 2459.0 feet, 2.4 feet higher than last year and 0.04 feet below full pool. This was the lake's peak summer level. During the first 12 days of August, releases from Libby were 24 kcfs but were reduced to 12 to 14 kcfs for the remainder of the month because of local flooding near Bonners Ferry. The full Biological Opinion water volume allocation for salmon flows was not released from Libby due to the Arrow Libby swap of nearly 200 ksfd, and this water was delivered from Arrow Lakes instead. September discharges were in the 8 to 12 kcfs range for an on-going Montana Fish Wildlife and Parks fishery study. At the start of the report year on 1 October 1996, the reservoir was at elevation 2448.7 feet. During October, Libby was operated for power and the reservoir was drafted to elevation 2439.3 feet. In November, Libby was operated for power, fish monitoring studies, and flood control and was drafted an additional 14 feet.

For the whole month of December, except for 4 days over Christmas, Libby outflows were maintained at a maximum of 20 kcfs for the 4 available units (1 unit was out of service for the whole month). The reservoir was drafted to elevation 2402.1 by the end of December which is 8.9 feet below the Upper Rule Curve. This was done to try to eliminate possible spill in January that might be required to get down to anticipated low flood control elevations in 1997.

During both January and February, all 4 available units of the project were operated at their maximum capacity to draft the reservoir storage and provide space for flood control. On 1 March, the April - August volume runoff forecast was reduced to 110 percent of normal. Outflows were reduced from 18 kcfs to 7 kcfs weekly average to reflect the new forecast volume. Libby average outflows of 8.7 kcfs in April and 13 kcfs in May were made in consideration of flood control needs and refill to provide for both sturgeon flows in June and salmon flows in August.

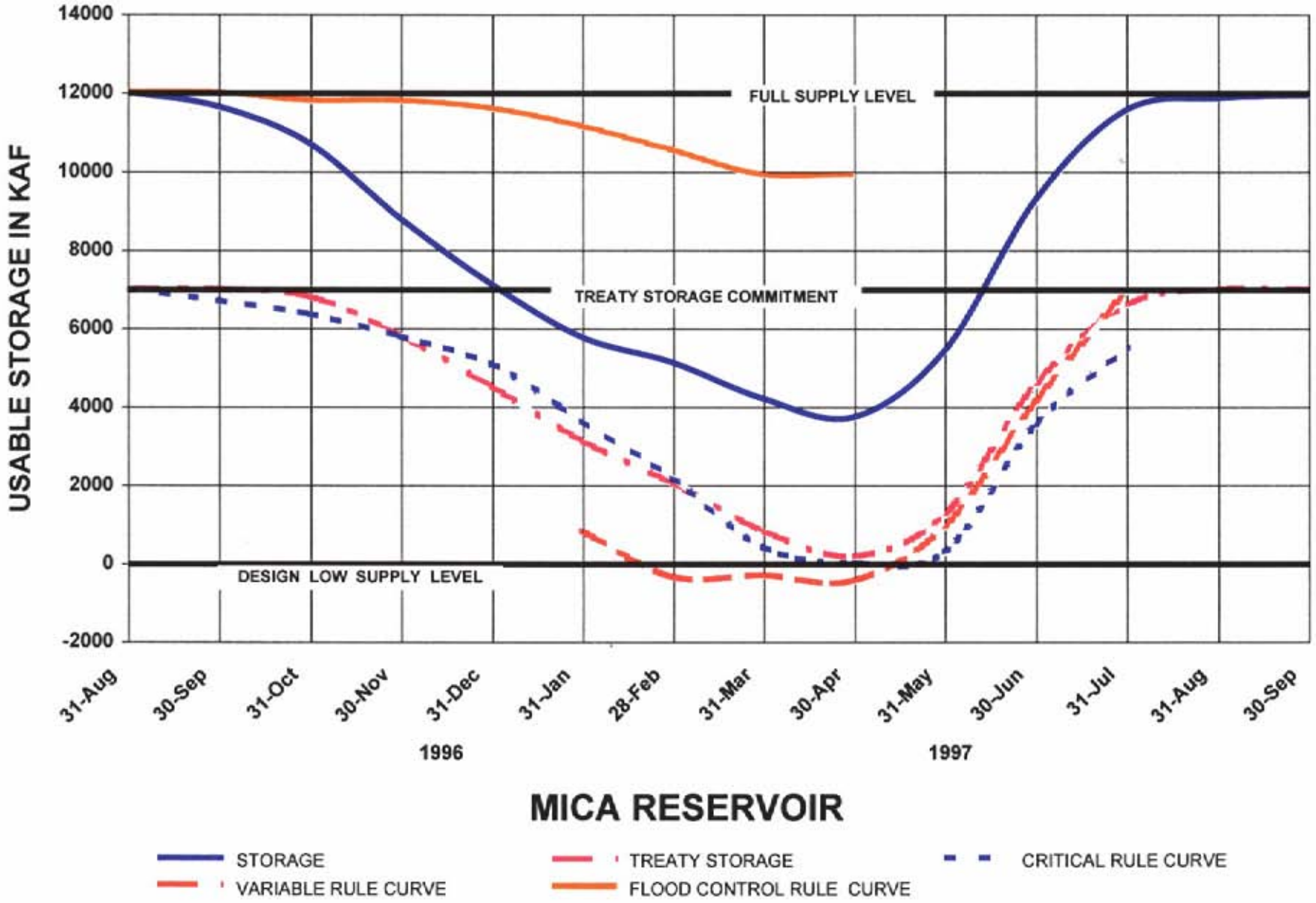
The U.S. Fish and Wildlife Service requested three pulsing operations in the outflows from Libby to release up to full powerhouse capacity to enhance sturgeon spawning above Bonners Ferry. Two of these pulses were provided during the periods of June 5 to 19 and of June 24 to 28.

By 16 July, outflow was reduced to 10 kcfs and reservoir elevation at the end of the month was near 2453 (6 feet from full). Outflow was maintained at 10 kcfs until 13 August when the Libby/Arrow storage exchange was initiated, at which time flow was increased to 14.5 kcfs. The Libby/Arrow storage exchange volume amounted to 190 kcfs. A maximum elevation of 2454.8 was reached on 12 August. At the end of August the elevation was 2450.1 feet, which was less than 10 feet from full. The final April to August seasonal runoff was 123 percent of normal. The observed reservoir level, at the end of the reporting year, on 30 September 1997 was 2447.4 feet.

Flood Control Operation

The Columbia River Basin reservoir system was operated for flood control once during the winter of 1996-97. Most of the flood contribution came from the Willamette River and lower Columbia River tributaries. Reductions in outflows from the Treaty storage projects were not required to alleviate flooding conditions in the Portland, Oregon-Vancouver, Washington area during this high water event because there was sufficient storage available in Grand Coulee to achieve flood control objectives. The peak regulated flow at The Dalles was 321,500 cfs on 5 January 1997 and the peak unregulated flow was 398,000 cfs on 3 January 1997. The observed peak stage at Vancouver, Washington was 22.1 feet, 6.1 feet over flood stage, on 2 January 1997. The unregulated stage for this event would have been 23.9 feet on 4 January 1997.

During the Spring freshet, the flood stage at Vancouver, Washington was exceeded during much of May and June. Significant flood reduction was provided by the Treaty projects in the course of regulating the 133 maf (143% of normal) April - August runoff volume at The Dalles. The peak unregulated flow at The Dalles would have been 896,000 cfs on 7 June 1997 and it was controlled to a maximum of 570,700 cfs on 15 June 1997. Of this flow reduction, approximately 170,000 cfs can be attributed to the Columbia River Treaty projects alone. The observed peak stage at Vancouver, Washington was 19.0 feet on 4 June 1997 and the unregulated stage would have been 28.4 feet on 8 June 1997. The monetary value of the damages prevented by operation of the Treaty storage for flood control was approximately $(US)197,000,000.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FULL SUPPLY LEVEL
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DESIGN LOW SUPPLY LEVEL
31-Aug
30-Sep
31-Oct
30-Nov
31-Dec
31-Jan
28-Feb
31-Mar
30-Apr
31-May
30-Jun
31-Jul
31-Aug
30-Sep
1996
1997
MICA RESERVOIR
STORAGE
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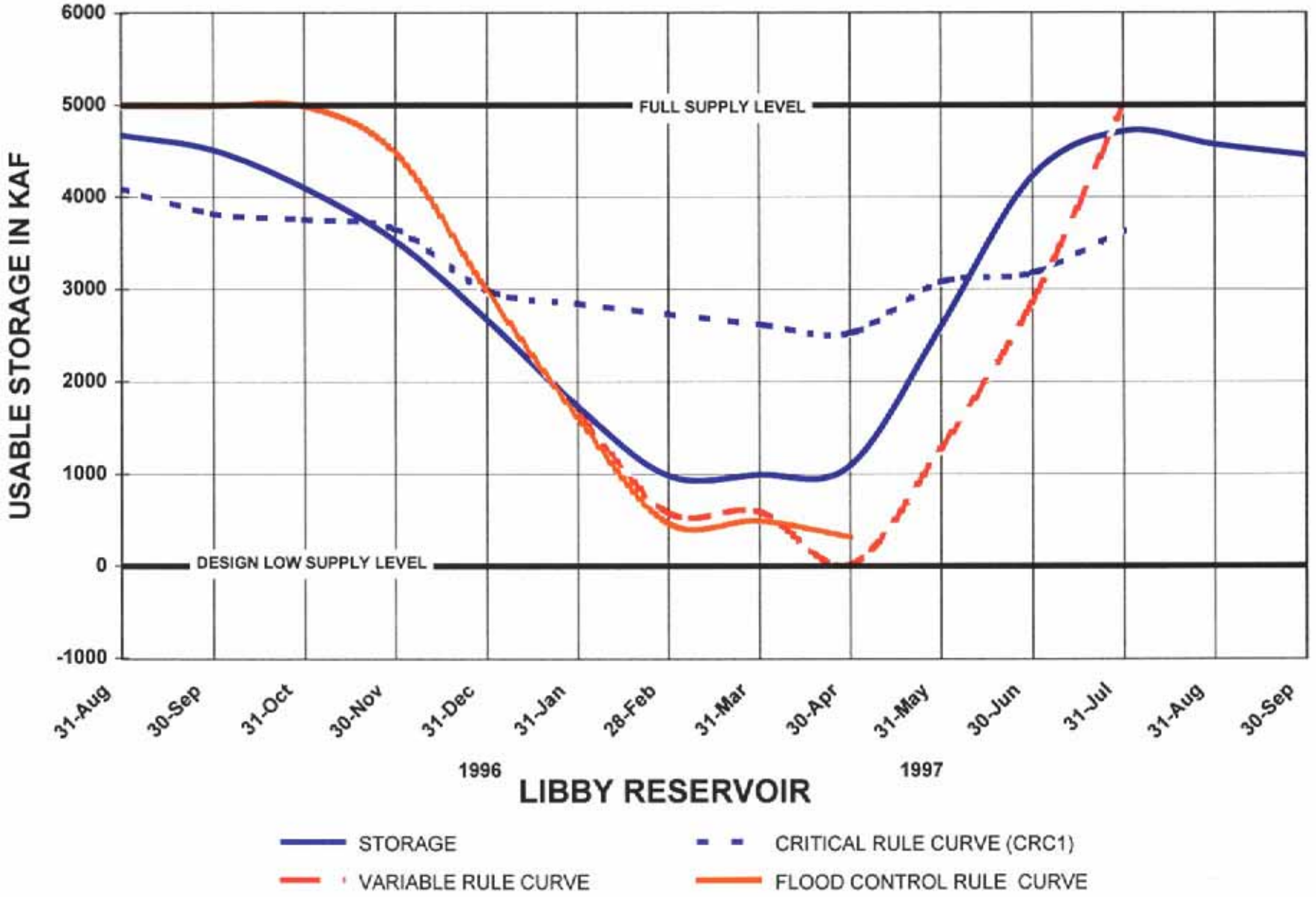
TREATY STORAGE
FLOOD CONTROL RULE CURVE
CRITICAL RULE CURVE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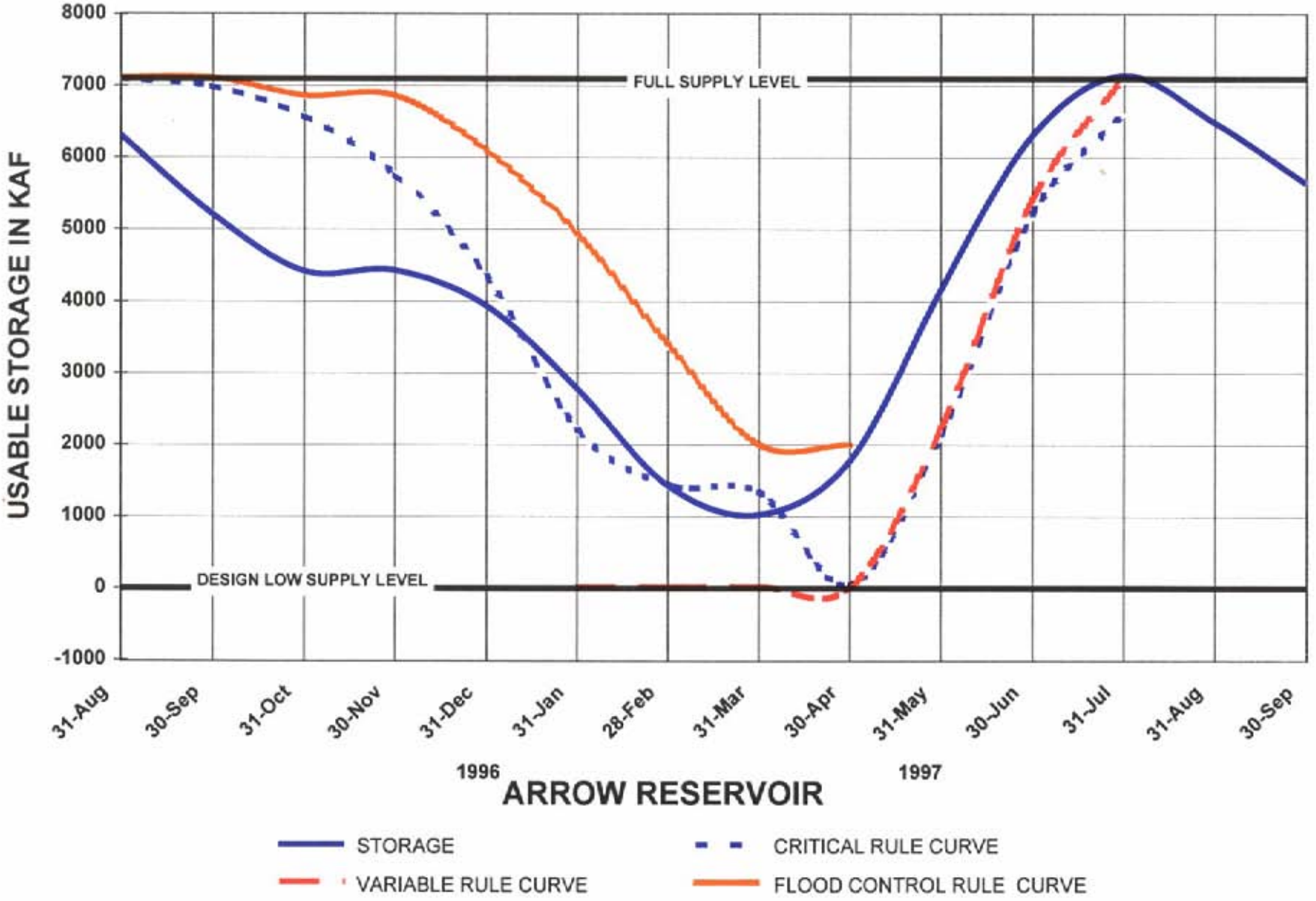
1996
1997
LIBBY RESERVOIR
STORAGE
CRITICAL RULE CURVE (CRC1)
VARIABLE RULE CURVE
FLOOD CONTROL RULE CURVE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30-Sep
31-Oct
30-Nov
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28-Feb
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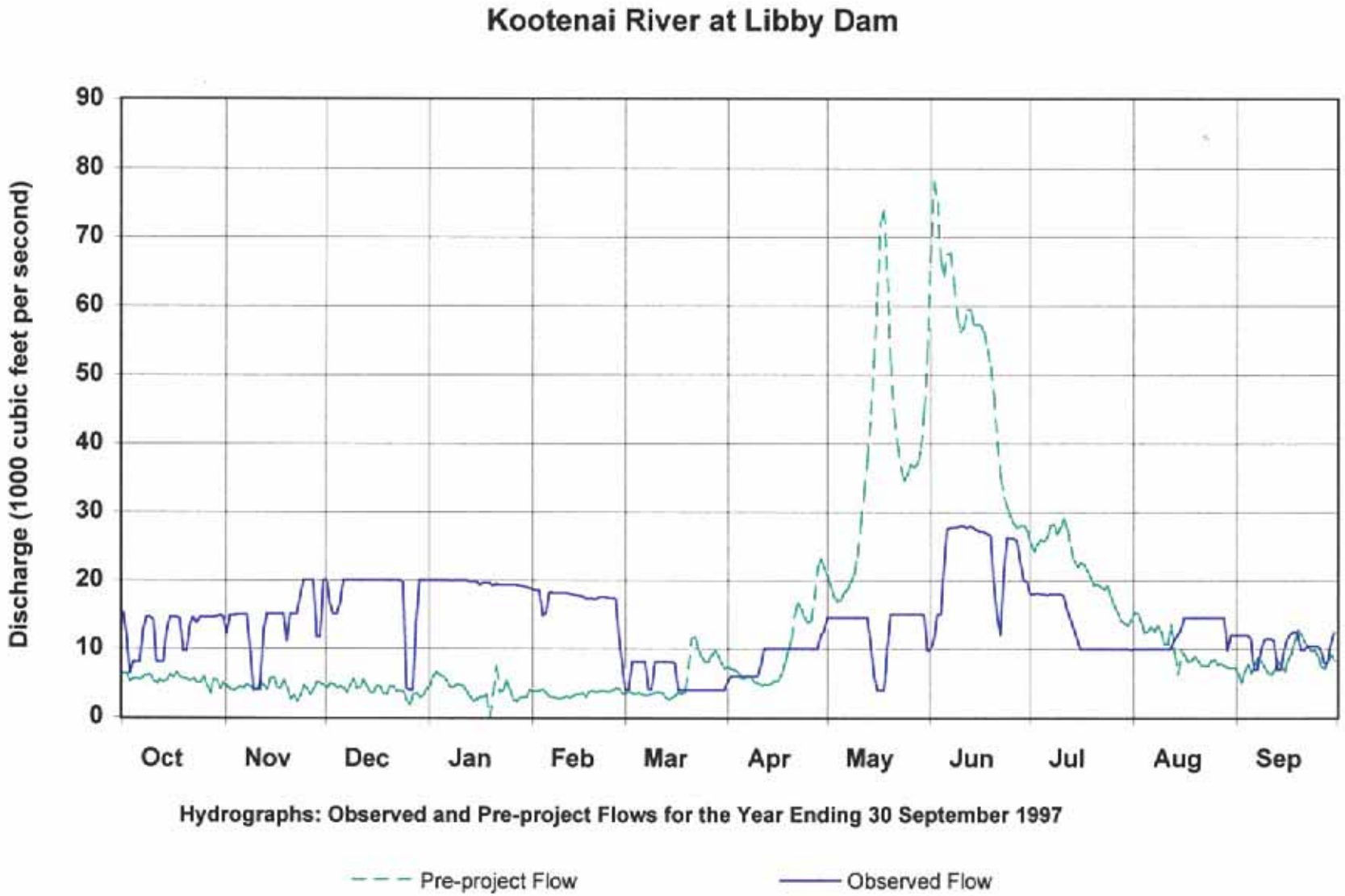
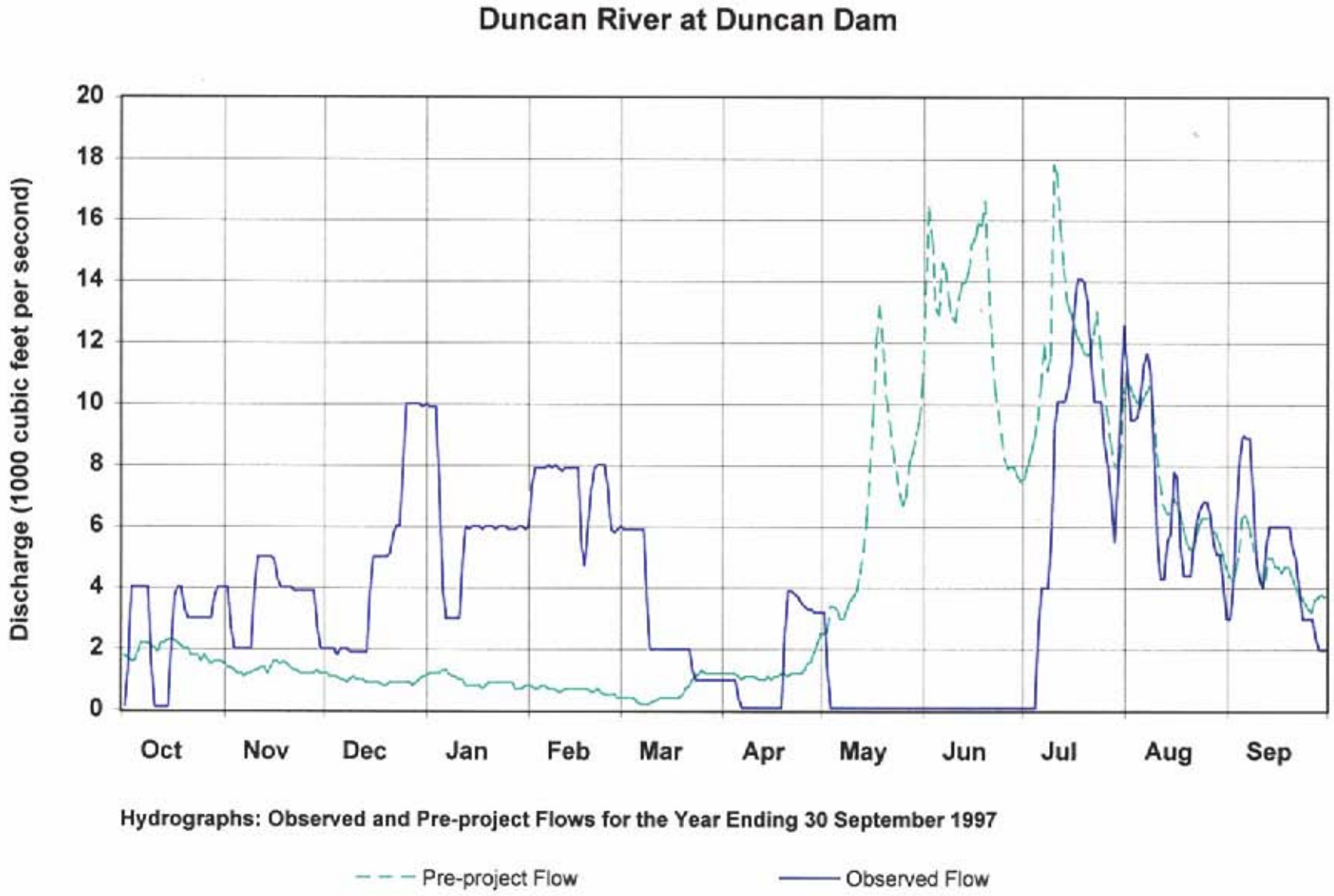
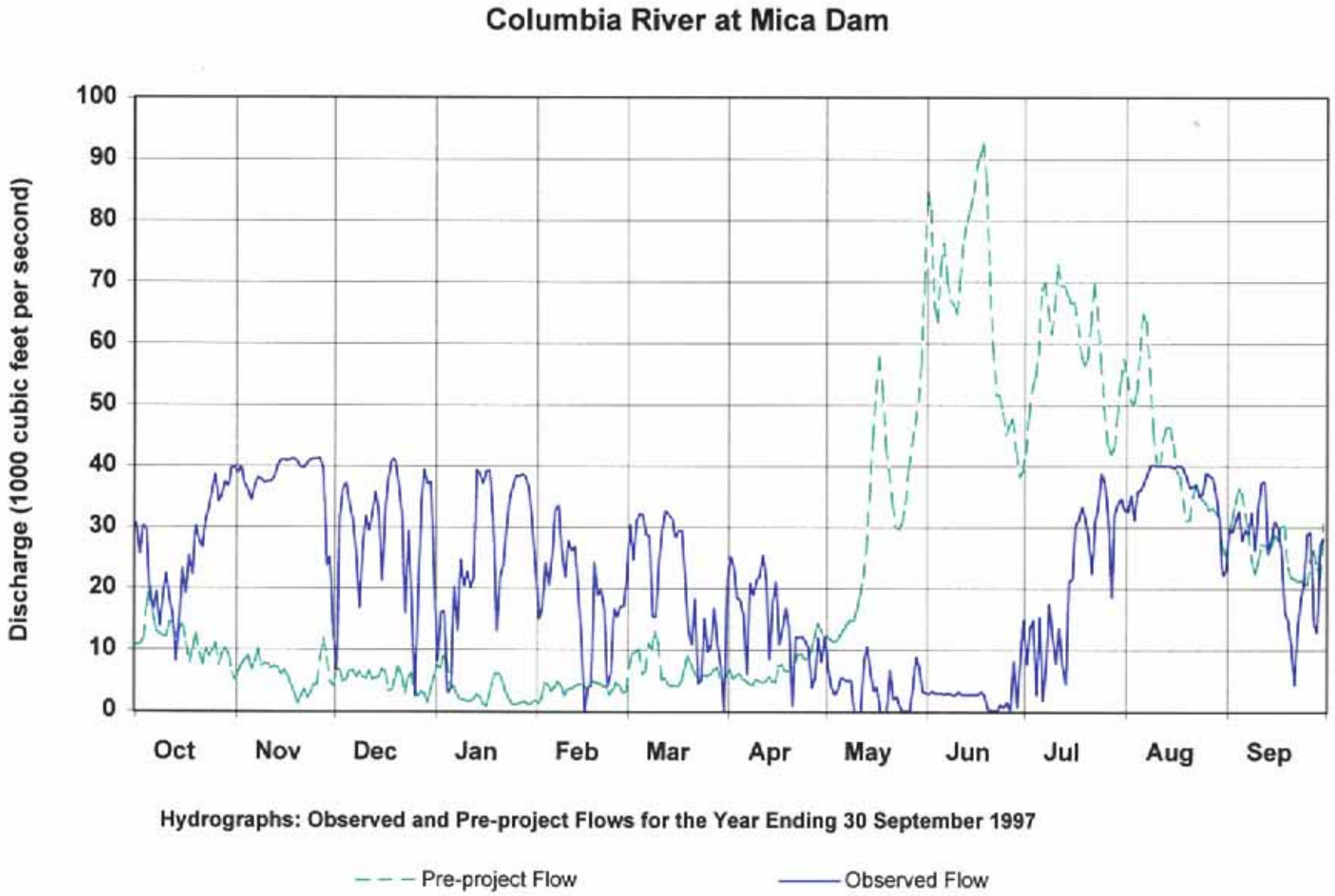


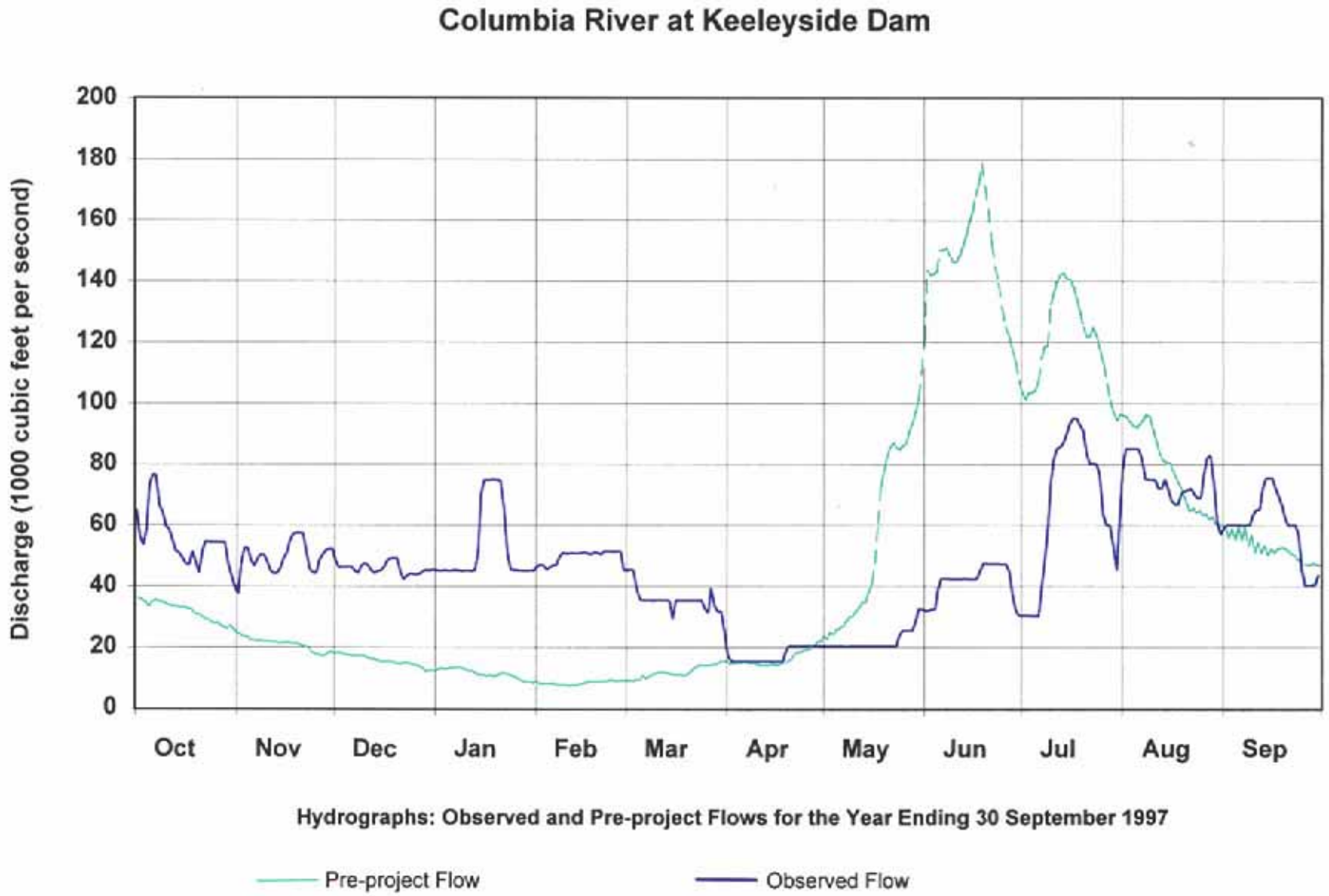
Hydrographs: Observed and Pre-project Flows for the Year Ending 30 September 1997



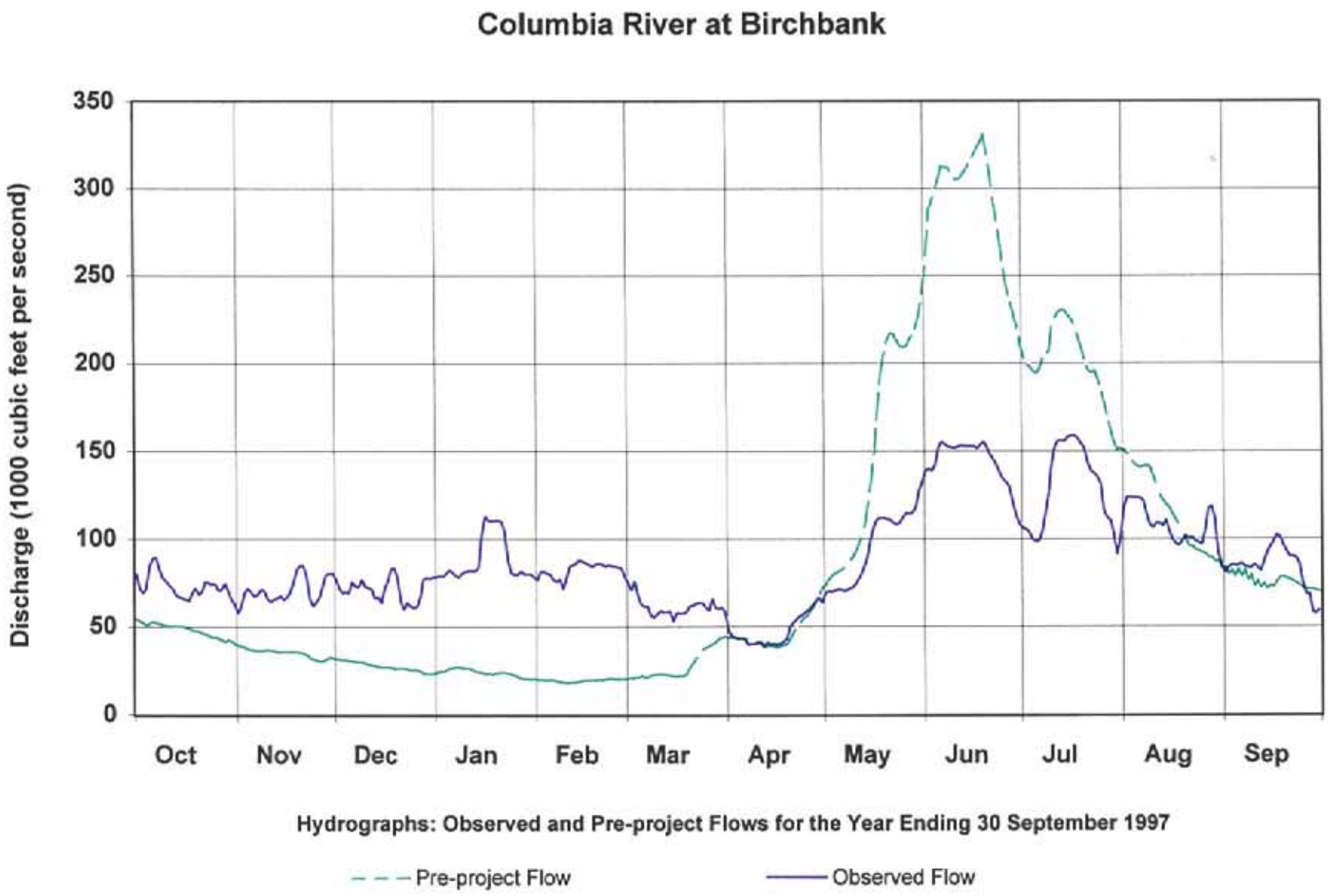
Hydrographs: Observed and Pre-project Flows for the Year Ending 30 September 1997



Hydrographs: Observed and Pre-project Flows for the Year Ending 30 September 1997



Hydrographs: Observed and Pre-project Flows for the Year Ending 30 September 1997


Columbia River at Birchbank
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300
250
200
150
100
50
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Hydrographs: Observed and Pre-project Flows for the Year Ending 30 September 1997
Pre-project Flow
Observed Flow

BENEFITS

Flood Control Provided

Significant flood damages would have occurred without the operation of the Treaty storage projects in the Spring of 1997. During the 1997 spring freshet, near-record streamflow levels would have occurred at Trail, British Columbia, and at The Dalles, Oregon, without the regulation provided by upstream reservoirs.

The peak regulated streamflows and stages for the major events experienced during the winter and spring are shown in the tables below:

Columbia River Streamflow at The Dalles, Oregon

Date	Peak Regulated Flow-cfs	Date	Peak Unregulated Flow-cfs
5 January 1997	321500	3 January 1997	398000
15 June 1997	570700	7 June 1997	896000

Columbia River Stage at Vancouver, Washington
(Flood Stage is 16.0 ft.)

Date	Peak Regulated Stage-ft.	Date	Peak Unregulated Stage-ft.
2 January 1997	22.1	4 January 1997	23.9
4 June 1997	19.0	8 June 1997	28.4

The operation of Columbia Basin reservoirs for the system as a whole reduced the natural peak discharge of the Columbia River near The Dalles, Oregon from about 398,000 cfs to 321,500 cfs during the January 1997 flood. In the spring of 1997, the system flood control operation reduced the natural peak discharge at The Dalles from 896,000 cfs to 570,700 cfs, for a stage reduction at Vancouver, Washington of 9.4 feet. It should be noted that, without the system flood control operation, the natural peak discharge at The Dalles would have been the fifth highest ever recorded.

It is estimated that the Duncan and Libby projects reduced the peak stage on Kootenay Lake by about 6.2 feet, and that the Duncan, Arrow, Mica and Libby projects reduced the peak stage of the Columbia River at Trail, British Columbia, by about 13.8 feet. The effect of storage in the Duncan, Arrow, Mica, and Libby reservoirs on flows at the sites, and on flows of the Columbia River at Birchbank, is illustrated by the hydrographs on pages 30 to 34, which show the actual discharges and the flows that would have occurred if the dams had not been built. The hydrograph showing pre-project conditions for Birchbank has been computed on the assumption that the effects of Duncan, Arrow, Mica

and Libby regulation, and of the regulation provided by the Corra Linn development on Kootenay Lake, have been removed.

The overall damage prevented by the operations of the Treaty storage projects alone for the period from 1 October 1996 to 30 September 1997 was about $(US)197,000,000.

All payments required by Article VI(1) of the Treaty as compensation for flood control provided by the Canadian Treaty storage have been made by the United States to Canada; the final payment was made on 29 March 1973 when the Mica project was declared operational.

Power Benefits

Downstream power benefits in the United States, which arise from operation of the Canadian Treaty storage, were pre-determined for the first thirty years of operation of each project, and the Canadian share was sold in the United States under the terms of the Canadian Entitlement Purchase Agreement. The U.S. Entity delivers capacity and energy to Columbia Storage Power Exchange participants, the purchasers of the Canadian entitlement. The benefits of additional generation made possible on the Kootenay River in Canada as a result of regulation provided by Libby, as well as generation at the Mica and Revelstoke projects, are retained by Canada. The benefits from Libby regulation, which occur downstream in the United States, are not shared under the Treaty.

During the operating year, 1 August 1996 through 31 July 1997, the downstream power benefits accruing to each country from the Treaty storage were determined, according to the procedures set out in the Treaty and Protocol, to be 547.5 megawatts of average annual energy and 1373.4 megawatts of capacity.

The Canadian Entitlement Purchase Agreement expires in stages over the period 1998 to 2003. The portion of Canada's share of downstream power benefits attributable to each of the Treaty projects is the ratio of each project's storage to the whole of the Canadian Treaty storage. The table below summarizes Canada's share of the downstream power benefits returnable from each project:

Treaty Storage	Date Returnable	Share of Canadian Entitlement-%
Duncan	1 April 1998	9
Arrow	1 April 1999	45.8
Mica	1 April 2003	45.2

After 1 April 2003, Canada's share of downstream benefits is fully returnable.

The agreement between the Entities, signed on 20 November 1996, sets out the details of delivery points and reliability of delivery for the downstream power benefits returnable to Canada beginning 1 April 1998. This agreement is also reported in the Reports Received Section on page 11 of this document.

Other Benefits

By agreement between the Entities, streamflows are regulated for non-power purposes, such as accommodating construction in river channels and providing water to meet fish needs in both countries. These arrangements are implemented under the Detailed Operating Plan and other agreements to provide mutual benefits.

CONCLUSIONS

1. During the operating year, 1 August 1996 through 31 July 1997, the downstream power benefits accruing to each country from the Treaty storage were determined, according to the procedures set out in the Treaty and Protocol, to be 547.5 megawatts of average annual energy and 1373.4 megawatts of capacity.

2. Flood control storage provided by the Treaty storage projects resulted in significant flood control benefits in terms of stage reductions and damage prevention. The April-August 1997 runoff volume for the Columbia River at The Dalles was 143% of normal. During this high runoff year, the Treaty storage projects contributed to reducing the peak stage at Vancouver, Washington in June 1997 from an unregulated stage of 28.4 feet down to an observed stage of 19.0 feet. The monetary value of the damages prevented by the operation the Treaty storage projects was approximately $(US)197,000,000.

3. The Entities continued to operate the hydrometeorological network as required by the Treaty.

4. The Board concludes that, based on the Entities agreement of 20 November 1996, appropriate arrangements have been made for the delivery of the Canadian Entitlement to Canada beginning April 1, 1998.

5. The Duncan, Arrow and Mica projects were operated in conformity with the Treaty during the 1996–1997 operating year. The operation reflected detailed operating plans developed by the Entities, the flood control operating plan for Treaty reservoirs, and other agreements between the Entities.

6. From October through December 1996, the Libby Dam project was operated for power requirements according to the Entities' report: Detailed Operating Plan (DOP) for Columbia River Treaty Storage for Operating Year 1996–1997. For the remainder of the operating year, the U.S. Entity operated Libby in accordance with the flood control operating plan and the U.S. fishery requirements to protect and enhance the white sturgeon and salmon population. The Canadian Entity believes that the fishery operations are inconsistent with the Treaty. The two governments are engaged in discussions to resolve the issue.

7. In July 1997, the Entities agreed on a DOP for the operating year 1997-1998 in conformance with the requirements of the Treaty. As in the previous DOP, the Libby project has two sets of operating rule curves, thus reflecting the Entities' disagreement over operation of the project.

8. The Board concludes that the disagreement between the Entities over Libby Dam fisheries operations has prevented the Entities from agreeing on the Assured Operating Plans (AOP) and Determinations of Downstream Power Benefits (DDPB) for upcoming operating years 2000-01, 2001-02 and 2002-03. The Treaty requires the Entities to prepare an AOP and the associated DDPB for each operating year six years in advance.

9. Based on the preceding conclusion, the Treaty requirements are not fully met.

APPENDIX A

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD

United States	Canada

Members

Mr. Steven Stockton, Chair Chief, Engineering Division Directorate of Civil Works H.Q., U.S. Army Corps of Engineers Washington, D.C.	Mr. Daniel Whelan, Chair Director General Energy Resources Branch Department of Natural Resources Ottawa, Ontario
Mr. Ronald Wilkerson Missoula, Montana	Mr. John Allan Deputy Minister Ministry of Forests Victoria, British Columbia

Alternates

Mr. Daniel Burns[1] Chief, Operation, Construction and Readiness Division Directorate of Civil Works H.Q., U.S. Army Corps of Engineers Washington, D.C.	Mr. David Burpee Director, Renewable and Electrical Energy Division Energy Resources Branch Department of Natural Resources Ottawa, Ontario
Mr. George E. Bell[2] Lake Oswego, Oregon	Mr. Prad Kharé[3] Deputy Comptroller of Water Rights Ministry of Environment, Lands and Parks Victoria, British Columbia

Secretaries

Mr. Richard DiBuono Senior Hydraulic Engineer Directorate of Civil Works H.Q., U.S. Army Corps of Engineers Washington, D.C.	Mr. David Burpee Director, Renewable and Electrical Energy Division Energy Resources Branch Department of Natural Resources Ottawa, Ontario

[1] Mr. Daniel Burns retired from the Board on 4 February 1997.
[2] Vice Mr. Thomas Weaver as of 27 January 1997.
[3] Vice Mr. Jack Farrell as of 21 January 1997.

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD

Record of Membership

Members

United States		Canada	
Mr. Wendell Johnson[1]	1964–1970	Mr. Gordon McNabb[1]	1964–1991
Mr. Morgan Dubrow	1964–1970	Mr. Arthur Paget	1964–1973
Mr. John Neuberger	1970–1973	Mr. Valter Raudsepp	1973–1974
Mr. Joseph Caldwell[1]	1971–1973	Mr. Ben Marr	1974–1987
Mr. Homer Willis[1]	1973–1979	Mr. Tom Johnson	1987–1988
Mr. King Mallory	1973–1975	Mr. Douglas Horswill	1989–1991
Mr. Raymond Peck, Jr.	1976–1977	Mr. John Allan	1991–
Mr. Emerson Harper	1978–1988	Mr. David Oulton[1]	1991–1996
Mr. Lloyd Duscha[1]	1979–1990	Mr. Daniel Whelan[1]	1996–
Mr. Ronald Wilkerson	1988–		
Mr. Herbert Kennon[1]	1990–1994		
Mr. John Elmore[1]	1994–1996		
Mr. Steven Stockton[1]	1996–		

Alternates

Mr. Fred Thrall	1964–1974	Mr. Mac Clark	1964–1992
Mr. Emerson Harper	1964–1978	Mr. Jim Rothwell	1964–1965
Mr. Alex Shwaiko	1974–1987	Mr. Hugh Hunt	1966–1988
Mr. Herbert Kennon	1987–1990	Dr. Donald Kasianchuk	1988–1996
Mr. Thomas Weaver	1979–1997	Mr. Vic Niemela	1992–1994
Mr. John Elmore	1990–1994	Mr. David Burpee	1994–
Mr. Paul Barber	1994–1995	Mr. Jack Farrell	1996–1997
Mr. Daniel Burns	1995–1997	Mr. Prad Kharé	1997–
Mr. George E. Bell	1997–		

Secretaries

Mr. John Roche	1965–1969	Mr. Mac Clark	1964–1992
Mr. Verle Farrow	1969–1972	Mr. David Burpee	1992–
Mr. Walter Duncan	1972–1978		
Mr. Shapur Zanganeh	1978–1995		
Mr. Richard DiBuono	1995–		

[1] Chair

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD

ENGINEERING COMMITTEE

Current Membership

United States	Canada
Mr. Richard DiBuono, P.E., Chair Directorate of Civil Works H.Q., U.S. Army Corps of Engineers Washington, D.C.	Mr. Roger McLaughlin, P.Eng., Chair Electricity Development Branch Ministry of Employment and Investment Victoria, British Columbia
Mr. Earl Eiker, P.E. Directorate of Civil Works H.Q., U.S. Army Corps of Engineers Washington, D.C.	Mr. David Burpee Renewable and Electrical Energy Division Department of Natural Resources Ottawa, Ontario
Mr. James Barton, P.E. Water Management Division U.S. Army Corps of Engineers Northwestern Division Portland, Oregon	Ms. Myriam Boudreault Renewable and Electrical Energy Division Department of Natural Resources Ottawa, Ontario
Mr. Robert Johnson, P.E. Resources and Transmission Planning Division Western Area Power Administration Loveland, Colorado	Dr. Bala Balachandran, P.Eng. Water Management Branch Ministry of Environment, Lands and Parks Victoria, British Columbia
Mr. James Fodrea, P.E. U.S. Bureau of Reclamation Pacific Northwest Region Boise, Idaho	Mr. Larry Adamache Aquatic and Atmospheric Sciences Division Environment Canada Vancouver, British Columbia

APPENDIX B

COLUMBIA RIVER TREATY ENTITIES

United States

Canada

Members

Mr. Randall Hardy, Chair
Administrator and Chief Executive Officer
Bonneville Power Administration
Department of Energy
Portland, Oregon

Mr. Brian Smith, Chair
British Columbia Hydro and
Power Authority
Vancouver, British Columbia

BG Robert H. Griffin[1]
Division Engineer
U.S. Army Engineer Division,
North Pacific
Portland, Oregon

[1] Vice Colonel Bartholomew Bohn as of 3 December 1996.

APPENDIX C

RECORD OF FLOWS

AT THE

INTERNATIONAL BOUNDARY

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	80.9	58.3	78.0	79.1	77.0	75.2	48.4	69.6	139.1	106.7	117.6	81.2
2	72.4	62.2	72.8	79.5	81.9	71.0	45.2	70.6	140.9	106.3	124.7	84.1
3	69.6	69.9	69.6	79.1	81.9	76.6	44.1	70.3	139.5	104.2	124.3	85.5
4	72.4	72.4	70.3	80.9	80.9	68.2	43.4	71.0	143.0	100.3	124.3	85.5
5	85.1	70.3	69.6	83.0	80.5	63.2	43.4	71.7	152.9	98.9	124.3	85.1
6	89.7	67.8	76.3	81.6	77.3	61.8	43.4	71.3	156.1	99.2	124.0	86.5
7	90.1	68.9	73.8	79.5	76.3	61.8	40.3	70.6	154.7	104.9	122.5	84.8
8	83.3	71.7	73.1	78.8	77.7	56.9	40.6	71.7	153.3	114.8	114.8	84.4
9	78.4	71.0	77.7	81.2	72.0	55.4	40.6	72.4	152.9	126.1	108.8	83.7
10	76.6	66.4	73.5	81.9	78.4	57.6	41.0	73.8	152.6	144.4	107.0	85.8
11	74.2	64.6	72.8	82.6	85.1	59.3	41.7	76.6	153.3	153.6	109.5	84.4
12	72.4	66.0	72.0	82.6	85.8	58.6	38.5	79.8	154.0	156.8	109.5	81.9
13	68.5	66.7	66.7	82.6	86.9	58.6	41.3	84.8	153.6	156.8	107.7	86.9
14	67.5	68.2	67.5	84.4	89.0	59.0	40.3	89.7	153.6	156.4	111.6	92.2
15	66.7	65.7	63.9	103.5	87.6	53.3	40.6	99.9	153.6	158.9	104.9	96.1
16	66.0	67.5	72.4	113.7	86.9	58.3	40.3	107.4	153.6	159.6	100.3	98.5
17	65.3	70.3	76.6	111.2	85.8	57.9	40.6	111.6	152.2	159.6	97.5	102.8
18	69.9	75.9	83.7	110.9	84.8	57.9	41.7	112.7	154.3	157.9	96.8	101.7
19	72.8	83.0	84.4	111.2	86.2	58.6	43.4	112.7	156.1	155.0	99.6	97.1
20	68.9	85.5	78.4	111.2	86.5	62.2	49.8	112.0	152.6	152.6	102.4	93.6
21	70.3	85.5	65.0	110.9	86.2	62.5	52.6	111.6	148.7	144.4	100.6	90.4
22	76.3	79.1	60.0	104.9	85.1	63.6	54.4	109.8	145.9	139.5	101.4	90.4
23	75.6	66.4	64.3	89.3	85.8	63.9	56.2	108.8	142.3	138.1	99.2	89.7
24	74.5	62.2	62.2	81.2	85.1	63.9	57.2	109.8	138.1	136.0	98.5	85.8
25	74.9	64.6	61.1	80.2	85.1	61.4	59.0	113.0	134.6	132.1	97.1	74.9
26	71.0	67.5	61.8	80.2	84.4	59.3	60.0	115.5	132.8	116.9	105.9	68.9
27	72.0	74.5	67.5	82.3	84.1	66.4	62.5	115.1	130.3	112.7	118.0	68.9
28	75.2	80.5	78.0	80.5	78.8	61.1	65.0	115.5	120.8	111.2	119.4	58.6
29	70.6	80.9	78.4	80.5		60.7	67.1	118.7	113.7	103.1	112.0	57.6
30	66.0	80.9	78.0	80.5		61.4	63.9	128.5	109.1	91.5	92.5	59.7
31	63.2	0.0	78.8	78.8		58.6		132.8		101.4	86.2	
Mean	73.5	71.0	72.0	88.6	83.0	61.8	48.4	96.1	144.4	128.9	108.4	84.1

COLUMBIA RIVER AT BIRCHBANK, BRITISH COLUMBIA - Daily discharges in thousands of cubic feet per second for the year ending 30 September 1997

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	17.8	14.4	21.2	23.3	21.2	10.7	15.1	37.4	54.7	26.8	11.8	13.3
2	14.7	14.6	21.1	26.3	21.1	7.2	15.9	35.6	52.8	24.9	11.8	13.2
3	12.2	15.9	17.3	27.3	21.0	7.3	16.0	33.7	48.4	24.4	11.9	13.3
4	7.6	15.9	16.3	26.6	20.6	10.4	16.2	33.0	46.9	24.1	11.7	13.3
5	9.0	16.1	16.3	25.3	16.7	10.7	15.5	33.4	47.0	23.5	11.5	13.2
6	9.1	16.1	18.7	24.4	18.0	10.8	14.8	34.3	52.8	23.3	11.5	12.1
7	9.3	16.1	21.4	23.9	20.2	10.8	14.4	36.8	53.7	23.4	11.4	8.7
8	14.2	16.2	21.4	23.7	20.2	10.9	14.2	38.1	52.5	22.9	11.4	8.5
9	15.2	10.0	21.6	23.3	20.0	7.6	13.9	38.1	51.3	22.8	11.4	11.0
10	15.4	5.7	21.6	23.3	19.8	7.7	13.7	40.2	50.4	23.7	11.2	12.3
11	13.7	5.6	21.5	23.1	20.0	11.1	13.1	45.4	50.6	23.5	11.2	12.4
12	9.4	5.9	21.4	22.6	20.2	11.4	14.5	49.5	51.1	22.2	11.2	12.5
13	9.2	14.3	21.4	22.1	20.0	11.3	16.3	54.4	48.6	20.2	11.2	11.7
14	9.4	16.1	21.3	21.6	19.9	11.0	16.7	61.4	48.0	18.3	12.9	8.6
15	14.5	16.4	20.9	21.6	19.9	11.1	16.9	61.0	47.6	16.7	13.4	8.5
16	15.6	16.2	20.8	21.7	19.8	10.9	17.3	59.0	47.7	15.0	14.8	12.0
17	15.6	16.2	20.8	21.8	20.0	11.2	18.3	58.1	46.2	13.7	15.7	14.1
18	15.7	16.2	20.8	21.4	20.1	8.5	20.7	52.8	44.6	13.6	15.7	16.6
19	14.6	16.3	20.9	21.7	20.0	9.4	22.3	42.6	43.0	13.3	15.6	15.9
20	11.2	12.9	21.0	21.9	20.1	16.2	24.2	43.4	39.6	13.1	15.6	14.4
21	11.2	15.9	21.1	21.7	20.1	25.0	33.6	43.3	32.1	12.9	15.6	12.1
22	15.1	16.5	20.9	21.5	20.2	23.3	34.7	41.0	26.3	13.0	15.4	11.8
23	15.7	16.6	20.6	21.3	20.1	19.6	32.5	39.2	23.5	12.8	15.3	11.9
24	14.8	19.5	20.5	21.3	20.0	17.7	30.5	38.6	32.9	12.7	15.4	11.8
25	15.7	21.0	18.0	21.5	19.9	16.4	29.2	42.4	35.5	12.5	15.6	11.7
26	15.8	21.1	6.5	21.0	19.9	16.3	29.2	47.2	35.2	12.4	15.8	11.7
27	15.7	21.3	6.0	20.5	19.8	19.7	32.6	45.3	34.7	12.4	15.9	11.0
28	15.7	21.5	6.3	20.4	14.0	21.3	43.4	43.2	33.1	12.2	15.7	9.8
29	16.3	11.8	17.3	20.8		19.7	43.2	42.8	29.9	12.1	15.1	9.7
30	16.3	15.5	20.4	21.0		17.5	40.0	45.6	28.0	12.5	12.0	12.6
31	16.2		21.0	21.4		16.0		49.0		12.2	13.3	
Mean	13.6	15.3	18.9	22.6	19.7	13.5	22.6	44.1	43.0	17.7	13.5	12.0

KOOTENAI RIVER AT PORTHILL, IDAHO - Daily discharges in thousands of cubic feet per second for the year ending 30 September 1997

APPENDIX D

PROJECT INFORMATION

Power and Storage Projects,

Northern Columbia Basin	Plate No. 1

Project Data

Duncan Project	Table No. 1
Arrow Project	Table No. 2
Mica Project	Table No. 3
Libby Project	Table No. 4

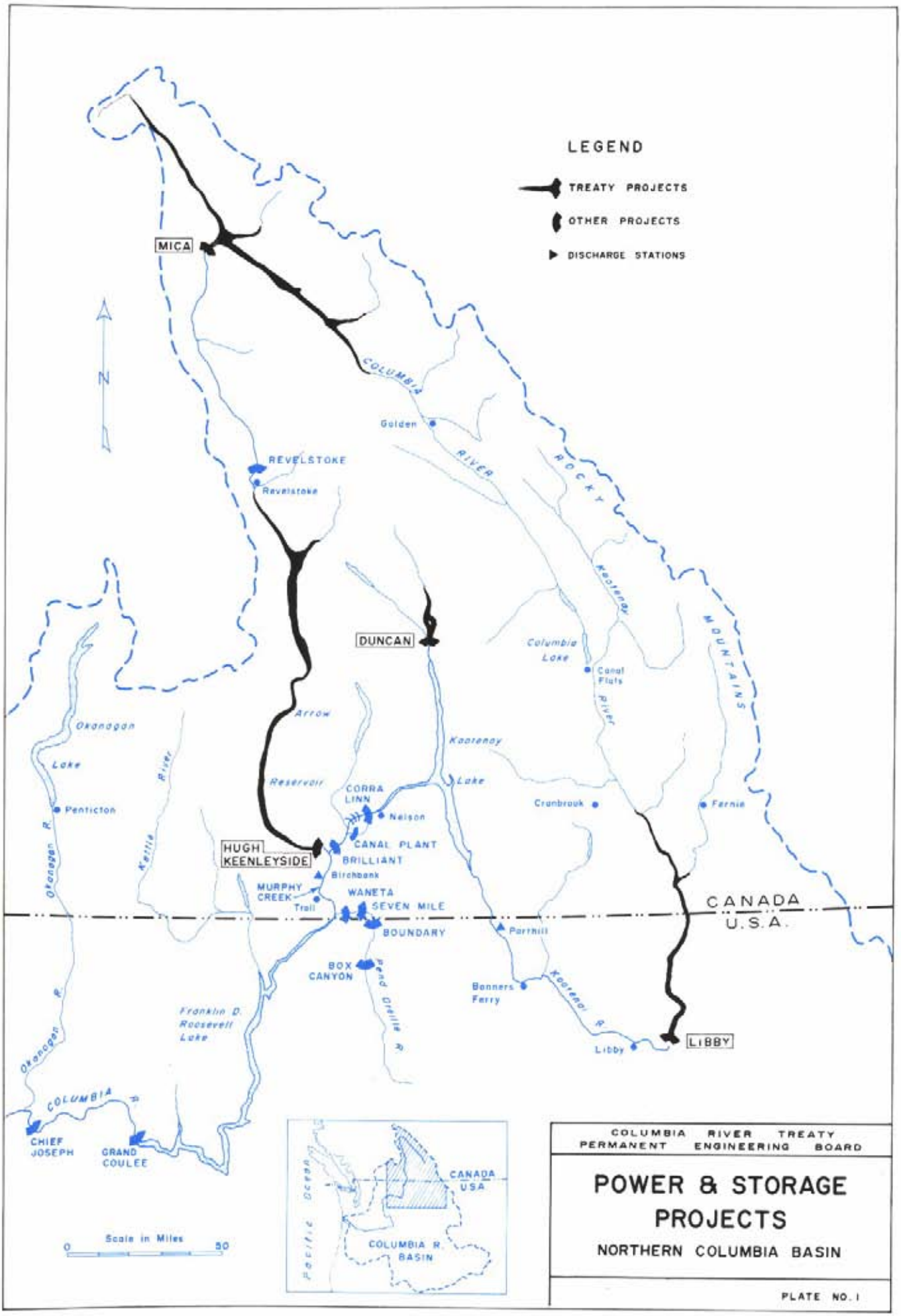
LEGEND
TREATY PROJECTS
OTHER PROJECTS
DISCHARGE STATIONS
MICA
N
COLUMBIA
Golden
RIVER
ROCKY
REVELSTOKE
Revelstoke
Kootenay
MOUNTAINS
DUNCAN
Columbia Lake
Canal Flats
River
Arrow
Okanogan
Lake
Kootenay
Lake
Reservoir
CORRA LINN
Nelson
Penticton
Okanogan R.
Kettle River
Cranbrook
Fernie
HUGH KEENLEYSIDE
CANAL PLANT
BRILLIANT
Birchbank
MURPHY CREEK
Trail
WANETA
SEVEN MILE
CANADA
U.S.A.
BOUNDARY
Parthill
BOX CANYON
Pend Oreille R.
Bonners Ferry
Kootenai R.
Franklin D. Roosevelt Lake
Libby
LIBBY
Okanogan R.
COLUMBIA
CHIEF JOSEPH
GRAND COULEE
Scale in Miles
0
50
CANADA
USA
Pacific Ocean
COLUMBIA R. BASIN
COLUMBIA RIVER TREATY
PERMANENT ENGINEERING BOARD
POWER & STORAGE PROJECTS
NORTHERN COLUMBIA BASIN
PLATE NO. 1

TABLE 1

DUNCAN PROJECT

Duncan Dam and Duncan Lake

Storage Project

Construction began	17 September 1964
Storage became fully operational	31 July 1967

Reservoir

Normal full pool elevation	1,892 feet
Normal minimum pool elevation	1,794.2 feet
Surface area at full pool	18,000 acres
Total storage capacity	1,432,400 acre-feet
Usable storage capacity	1,400,000 acre-feet
Treaty storage commitment	1,400,000 acre-feet

Dam, Earthfill

Crest elevation	1,907 feet
Length	2,600 feet
Approximate height above riverbed	130 feet
Spillway—Maximum capacity	47,700 cfs
Discharge tunnels—Maximum capacity	20,000 cfs

Power Facilities

None

TABLE 2

ARROW PROJECT

Hugh Keenleyside Dam and Arrow Lakes

Storage Project

Construction began	March 1965
Storage became fully operational	10 October 1968

Reservoir

Normal full pool elevation	1,444 feet
Normal minimum pool elevation	1,377.9 feet
Surface area at full pool	130,000 acres
Total storage capacity	8,337,000 acre-feet
Usable storage capacity	7,100,000 acre-feet
Treaty storage commitment	7,100,000 acre-feet

Dam, Concrete Gravity and Earthfill

Crest elevation	1,459 feet
Length	2,850 feet
Approximate height above riverbed	170 feet
Spillway—Maximum capacity	240,000 cfs
Low-level outlets—Maximum capacity	132,000 cfs

Power Facilities

None

TABLE 3

MICA PROJECT

Mica Dam and Kinbasket Lake

Storage Project

Construction began	September 1965
Storage became fully operational	29 March 1973

Reservoir

Normal full pool elevation	2,475 feet
Normal minimum pool elevation	2,320 feet
Surface area at full pool	106,000 acres
Total storage capacity	20,000,000 acre-feet
Usable storage capacity	12,000,000 acre-feet
Treaty storage commitment	7,000,000 acre-feet

Dam, Earthfill

Crest Elevation	2,500 feet
Length	2,600 feet
Approximate height above foundation	800 feet
Spillway—Maximum capacity	150,000 cfs
Outlet works—Maximum capacity	37,400 cfs

Power Facilities

Designed ultimate installation	
6 units at 434 MW	2,604 MW
Power commercially available	December 1976
Currently installed	
4 units at 434 MW	1,736 MW
Head at full pool	600 feet
Maximum turbine discharge	
of 4 units at full pool	38,140 cfs

TABLE 4

LIBBY PROJECT

Libby Dam and Lake Koocanusa

Storage Project

Construction began	June 1966
Storage became fully operational	17 April 1973

Reservoir

Normal full pool elevation	2,459 feet
Normal minimum pool elevation	2,287 feet
Surface area at full pool	46,500 acres
Total storage capacity	5,869,000 acre-feet
Usable storage capacity	4,980,000 acre-feet

Dam, Concrete Gravity

Deck elevation	2,472 feet
Length	3,055 feet
Approximate height above riverbed	370 feet
Spillway—Maximum capacity	145,000 cfs
Low level outlets—Maximum capacity	61,000 cfs

Power Facilities

Designed ultimate installation	
8 units at 105 MW	840 MW
Power commercially available	24 August 1975
Currently installed	
5 units at 105 MW	525 MW
Head at full pool	352 feet
Maximum turbine discharge	
of 5 units at full pool	26,500 cfs

United States Entity

Columbia River Treaty
P.O. Box 3621, Portland. OR 97208-3621

Chairman:
Administrator
Bonneville Power Administration
Department of Energy

Member
Division Engineer
North Pacific Division
Corps of Engineers
Department of the Army

27 November 1996

In reply refer to: PGPL

Mr. Steve Stockton
Chair, U.S. Section
Columbia River Treaty
Permanent Engineering Board
HQ, U.S. Army Corps of Engineers
20 Massachusetts Avenue NW
Washington, D.C. 20314-1000

Dear Mr. Stockton:

Re: **Resolution of Entity Differences**

This letter reports on the status of resolution of various issues which have been in dispute between the Canadian and U.S. Entities. These issues are discussed in the Board's 18 October 1995 letters to the Entities, and are summarized as follows:

- Interpretation of the Treaty definition for "critical stream flow period"
- Principles and procedures for incorporating and revising non-power requirements (NPRs) in AOP/DDPB studies
- Summary description of the changes and impacts of changes to NPRs
- Rights and obligations of the Entities with respect to entitlement delivery, including return to Oliver, provisions for east-west standby, and consideration of alternative delivery points.

As discussed in the 26 September 1996 letter from the Entities to the Board, the Entities consider that the first two issues are resolved or rendered moot by the Entity agreement entitled, "Columbia River Treaty Entity Agreement on Resolving the Dispute on Critical Period Determination, the Capacity Entitlement for the 1998/99, 1999/00 and 2000/01 AOP/DDPB's, and the Operating Procedures for the 2001/02 and Future AOP's", dated 29 August 1996. Copies of this agreement were forwarded to the Board with the 26 September correspondence. The Entities will attach copies of this agreement to the respective AOPs, and will forward copies of the agreement to recipients of those AOPs, to indicate the appropriate DDPB Capacity (Draft for Power) value to use.

The Entities consider further that the issues in respect of entitlement return for the period 1 April 1998 through 15 September 2024 are resolved by the attached agreement, "Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for 1

April 1998 through 15 September 2024, between the Canadian Entity and the United States Entity," dated 20 November 1996. The specific entitlement delivery issues brought forward to the Board by the Canadian Entity in July 1995, following cancellation of the July 1994 Memorandum of Negotiators Agreement (MONA), were as follows:

- The obligations of the US Entity regarding delivery to Oliver.
- The east-west standby transmission obligation under Article X.
- Consideration of alternative delivery points and reliability of delivery.

While this agreement in principle is binding on the Entities for deliveries to the Canada-U.S. border, the Entities also intend to pursue an exchange of notes between the US and Canadian Federal governments by 1 July 1997. The purpose of the exchange of notes is to satisfy Section 1, Article VIII of the Treaty, which requires an exchange of notes setting out conditions and limits for disposal of portions of the Canadian Entitlement in the United States.

As a result of the attached agreement (10 copies), and the previously forwarded agreement, the Entities consider the issues related to interpretation of "critical stream flow period", implementation of non-power requirements in AOP/DDPB studies, and arrangements for entitlement return to be fully addressed. The Canadian Entity will not be pursuing the dispute resolution mechanisms in the Treaty for the afore-mentioned issues and no longer requires the assistance of the Permanent Engineering Board to resolve these issues.

The Entities wish to thank the Board for their time and effort in assisting the Entities to resolve the issues, and in particular for the Board's 18 October 1995 communications in respect to the issues and to clarify the Board's role.

Sincerely,

Randall W. Hardy
Chair, U.S. Entity

Col. Bartholomew B. Bohn II
Member, U.S. Entity

Enclosures: as

cc: Doug Robinson - Secretary, Canadian Entity

BC hydro

proud of our Service

Brian R.D. Smith, Q.C.
Chair

December 9, 1996

Mr. Daniel Whelan
Chair, Canadian Section
Columbia River Treaty
Permanent Engineering Board
Natural Resources Canada
Ottawa, Ontario
K1A 0E4

Dear Mr. Whelan:

Re: Resolution of Entity Differences

This letter reports on the status of resolution of various issues which have been in dispute between the Canadian and U.S. Entities. These issues are discussed in the Board's 18 October 1995 letters to the Entities, and are summarized as follows:

- Interpretation of the Treaty definition for "critical stream flow period".
- Principles and procedures for incorporating and revising non-power requirements (NPRs) in AOP/DDPB studies.
- Summary description of the changes and impacts of changes to NPRs.
- Rights and obligations of the Entities with respect to entitlement delivery, including return to Oliver, provisions for east-west standby, and consideration of alternative delivery points.

As discussed in the 26 September 1996 letter from the Entities to the Board, the Entities consider that the first two issues are resolved or rendered moot by the Entity Agreement entitled, "Columbia River Treaty

Entity Agreement on Resolving the Dispute on Critical Period Determination, the Capacity Entitlement for the 1998/99, 1999/00 and 2000/01 AOP/DDPB's, and the Operating Procedures for the 2001/02 and Future AOP's", dated 29 August 1996. Copies of this Agreement were forwarded to the Board with the 26 September correspondence. The Entities will attach copies of this Agreement to the respective AOPs, and will forward copies of the Agreement to recipients of those AOPs, to indicate the appropriate DDPB Capacity (Draft for Power) value to use.

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- The obligations of the U.S. Entity regarding delivery to Oliver.
- The east-west standby transmission obligation under Article X.
- Consideration of alternative delivery points and reliability of delivery.

While this agreement in principle is binding on the Entities for deliveries to the Canada-U.S. border, the Entities also intend to pursue an exchange of notes between the U.S. and Canadian Federal governments by 01 July 1997. The purpose of the exchange of notes is to satisfy Section 1, Article VIII of the Treaty, which requires an exchange of notes setting out conditions and limits for disposal of portions of the Canadian Entitlement in the United States.

As a result of the attached agreement (10 copies), and the previously forwarded Agreement, the Entities consider the issues related to interpretation of "critical stream flow period", implementation of non-power requirements in AOP/DDPB studies, and arrangements for entitlement return to be fully addressed. The Canadian Entity will not be pursuing the dispute resolution mechanisms in the Treaty for the aforementioned issues and no longer requires the assistance of the Permanent Engineering Board to resolve these issues.

The Entities wish to thank the Board for their time and effort in assisting the Entities to resolve the issues, and in particular for the Board's 18 October 1995 communications in respect to the issues and to clarify the Board's role.

Yours truly,

Brian R. D. Smith
Chair
Canadian Entity

Enclosures

c: Mr. Tony White, Secretary, U.S. Entity

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD
CANADA • UNITED STATES

Info Only: A-2, SFH(AB), AN, AR, AC, P, PG, PGF, E, L, PGPL

28 March 1997

Mr. Randall W. Hardy
Chairman, United States Entity
Columbia River Treaty
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

Dear Mr. Hardy:

I am writing in reply to your 27 November 1996 letter to the U.S. Section of the Board regarding two recent agreements between the Entities. The agreements resolve differences between the Entities concerning the preparation of assured operating plans (AOP), determination of downstream power benefits (DDPB) and delivery of the Canadian entitlement to those benefits.

The Board agrees with the Entities that the agreement signed on 29 August 1996 brings the 1998/99 and 1999/00 AOP's and DDPB's into compliance with the Treaty by producing a single value of the downstream power benefit in each of those years. The Board will report this conclusion to the governments of Canada and the United States in its annual report for 1996.

The Board is concerned, however, that the agreement does not fully resolve the differences between the Entities on the definition of critical streamflow period. The Entities advised the Board that there is the possibility of two critical streamflow periods, and thus two values of the capacity benefit, being calculated in future AOP's and DDPB's. If this occurs, the Board will reexamine the matter based on the recommendations set out in the Board's letter to the Entities of 18 October 1995. The Board also will report this concern to the governments.

With regard to the agreement of 20 November 1996 concerning delivery of Canada's entitlement to downstream power benefits, the Board is pleased that the Entities have resolved their differences over alternate delivery points and transmission reliability. In our view, the agreement greatly increases the likelihood that the Entities will reach full agreement on all aspects of the return of the Canadian entitlement for the second thirty-year period of the Treaty. As the Board indicated in our letter to the Entities of 18 October 1995, the Board considers the ability to return the Canadian entitlement in the time frame required by the Treaty to be of paramount importance.

The Board applauds the Entities for resolving their differences and achieving agreement. It further recognizes that agreement was not accomplished without the hard work and dedication of

many individuals on both sides. To show our pleasure with the progress made thus far, the Board is dedicating its 1996 Annual Report to the Entities. It is our hope that the Entities will work in the same spirit of cooperation as you continue to implement the terms of the Treaty.

Sincerely yours,

Steven L. Stockton, P.E.
Chairman, United States Section

cf: Board and Engineering
Committee Members

COLUMBIA RIVER TREATY PERMANENT ENGINEERING BOARD
CANADA • UNITED STATES

CANADIAN SECTION
D.R. Whelan, Chair
J. Allan, Member

UNITED STATES SECTION
S.L. Stockton, Chair
R.H. Wilkerson, Member

27 March 1997

Mr. Brian R.D. Smith, Q.C.
Chair, BC Hydro and Power Authority
333 Dunsmuir Street, 18th floor
Vancouver, British Columbia
V6B 5R3

Dear Mr. Smith:

I am writing in reply to your letter of 9 December 1996 regarding two recent agreements between the Entities. The agreements resolve differences between the Entities concerning the preparation of the assured operating plans (AOP), determination of downstream power benefits (DDPB) and delivery of the Canadian entitlement to the power benefits.

The Board agrees with the Entities that the agreement signed on 29 August 1996 brings the 1998/99 and 1999/2000 AOP and DDPB reports into compliance with the Treaty by producing a single value for the downstream power benefit in each of those years. The Board will report this conclusion to the governments of Canada and the United States in its annual report for 1996.

The Board is concerned, however, that the agreement does not fully resolve the differences between the Entities concerning the critical streamflow period definition. You advised the Board that there is the possibility of two critical streamflow periods, and thus two values for the capacity benefit, being calculated in future AOP and DDPB reports. If this occurs, the Board will reexamine the matter based on the recommendations set out in the Board's letter to the Entities of 18 October 1995. The Board also will report this concern to the governments.

With regard to the agreement of 20 November 1996 concerning delivery of the Canadian entitlement, the Board is pleased that the Entities have resolved their differences over alternate delivery points and transmission reliability. In our view, the agreement greatly increases the likelihood that the Entities will reach agreement on all aspects of the return of Canadalls entitlement for the second thirty-year period of the Treaty. As indicated in our

letter of 18 October 1995, the Board considers that the ability to return the Canadian entitlement in the time frame required by the Treaty is of paramount importance.

The Board applauds the Entities for resolving their differences and achieving agreement. It further recognizes that agreement was not accomplished without the hard work and dedication of many individuals on both sides. To show its pleasure with the progress made thus far, the Board is dedicating its 1996 Annual Report to the Entities. It is our hope that the Entities will work in the same spirit of cooperation as you continue to implement the terms of the Treaty.

Yours sincerely,

Daniel Whelan
Chair, Canadian Section
Permanent Engineering Board

BC hydro

proud of our Service

May 6, 1997

Brian R.D. Smith, Q.C.
Chair

Mr. Daniel Whelan
Chair, Canadian Section
Columbia River Treaty Permanent Engineering Board
Natural Resources Canada
Ottawa, Ontario
K1A-0E4

Dear Mr. Whelan:

I am replying to your letter of March 27, 1997, regarding the Columbia River Treaty Permanent Engineering Board (the "Board") comments on the two recent Entity agreements on resolution of Entity differences related to determination of downstream power benefits ("DDPB"), preparation of assured operating plans, and the delivery of the Canadian Entitlement to the power benefits.

We understand the Board's concern regarding the potential for two values of the capacity benefit for the two critical stream flow periods ("CSFP") that could result under the alternative interpretations put forward by the Canadian and U.S. Entities and note the Board's intention to re-examine the matter based on the recommendations set out in the Board's letter to the Entities of October 18, 1995 should such an event occur. The Entities believe, however, that the reduced set of non-power requirements ('established operating procedures') currently agreed to by the Entities, and which may only be changed by mutual agreement between the Entities, ensure that the probability of conditions occurring in the DDPB studies which would give rise to two CSFPs is extremely remote. The Entities also anticipate that there would be some forewarning before such conditions occurred and that the Entities could advise the Board in advance.

We appreciate the Board's endorsement of the agreements reached between the Entities, and its decision to dedicate the 1996 PEB Annual Report to the Entities.

Yours very truly,

Brian R. D. Smith
Chair
Canadian Entity

British Columbia Hydro and Power Authority, 333 Dunsmuir Street, Vancouver B.C. V6B 5R3
Telephone (604) 623-4480 Fax (604) 623-3901

United States Entity

Columbia River Treaty
P.O. Box 3621, Portland, OR 97208-3621

Chairman:
Administrator
Bonneville Power Administration
Department of Energy

Member
Division Engineer
North Pacific Division
Corps of Engineers
Department of the Army

APR 12 1997

In reply refer to: PGPL

Mr. Steve Stockton
Chair, U.S. Section
Columbia River Treaty Permanent Engineering Board
HQ, U.S. Army Corps of Engineers - CECW
20 Massachusetts Avenue N.W.
Washington, D.C. 20314-1000

Dear Mr. Stockton:

We are replying to your letter of March 27, 1997, regarding the Columbia River Treaty Permanent Engineering Board (the Board) comments on the two recent Entity agreements on resolution of Entity differences related to determination of downstream power benefits ("DDPBs"), preparation of assured operating plans, and the delivery of the Canadian Entitlement to the power benefits.

We understand the Board's concern regarding the potential for two values of the critical stream flow period ("CSFP") that could result under the alternative interpretations put forward by the Canadian and U.S. Entities and note the Board's intention to re-examine the matter based upon the recommendations set forth in the Board's letter to the Entities of October 18, 1995, should such an event occur. The Entities believe, however, that the reduced set of nonpower requirements ("established operating procedures") currently agreed to by the Entities, and which may only be changed with mutual agreement between the Entities, ensure that the probability of conditions occurring in the DDPB studies which would give rise to two CSFP values is extremely remote. The Entities also anticipate that there would be some forewarning before such conditions actually occurred and that the Entities could advise the Board in advance.

We appreciate the Board's endorsement of the agreements reached between the Entities, and its decision to dedicate the 1996 PEB Annual Report to the Entities.

Sincerely,

Randall W. Hardy
Chair, U.S. Entity

BG Robert H. Griffin
Member, U.S. Entity